US011297373B2

(12) **United States Patent**
Ashraf et al.

(10) **Patent No.: US 11,297,373 B2**
(45) **Date of Patent: *Apr. 5, 2022**

(54) **TECHNIQUES FOR AUTHORIZING CONTROLLER DEVICES**

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(72) Inventors: **Zaka Ur Rehman Ashraf**, Pleasanton, CA (US); **Anush G. Nadathur**, San Jose, CA (US); **Jared S. Grubb**, San Francisco, CA (US); **Srinivas Rama**, Cupertino, CA (US)

(73) Assignee: **APPLE INC.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/815,314**

(22) Filed: **Mar. 11, 2020**

(65) **Prior Publication Data**

US 2020/0213656 A1 Jul. 2, 2020

Related U.S. Application Data

(63) Continuation of application No. 16/140,470, filed on Sep. 24, 2018, now Pat. No. 10,595,073.
(Continued)

(51) **Int. Cl.**
H04N 21/422 (2011.01)
G10L 15/26 (2006.01)

(52) **U.S. Cl.**
CPC ***H04N 21/42225*** (2013.01); ***G10L 15/26*** (2013.01); ***H04N 21/42203*** (2013.01); ***H04N 21/42208*** (2013.01)

(58) **Field of Classification Search**
CPC ... H04N 2201/3266; H04N 2201/3226; H04N 21/42225; H04N 21/42203;
(Continued)

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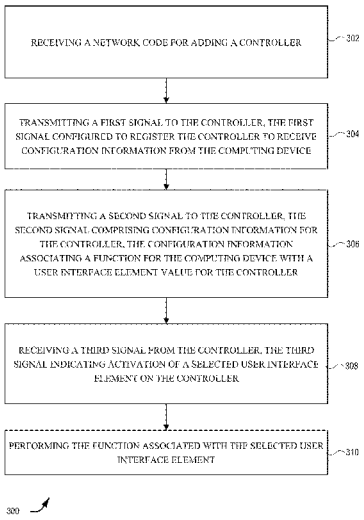
Primary Examiner — Paulos M Natnael
(74) *Attorney, Agent, or Firm* — Kilpatrick, Townsend and Stockton LLP

(57) **ABSTRACT**

Embodiments of the present disclosure present devices, methods, and computer readable medium for enabling controller device to control proprietary digital media players, network accessories, and virtual assistants, providing an overall improved user experience. The techniques disclosed herein reduce clutter because a single controller can control various different devices and accessories. The techniques discloses also can include identifying a change in the configuration information for the computing device. The technique for accessory control can include transmitting updated configuration information for the controller, the configuration information associating a function for the computing device with a user interface element value for the controller.

20 Claims, 11 Drawing Sheets



Related U.S. Application Data

(60) Provisional application No. 62/679,922, filed on Jun. 3, 2018.

(58) **Field of Classification Search**
CPC H04N 21/42208; H04N 21/42222; H04N 21/4126; G10L 15/26; G06F 3/167; H04L 12/2803; H04L 12/2807; H04L 12/2816
See application file for complete search history.

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10,893,157	B2 *	1/2021	Katsumata	H04N 1/00403
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2004/0075642	A1	4/2004	Kisliakov	
2004/0192206	A1	9/2004	Hirvonen	
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2006/0168618	A1	7/2006	Choi	
2007/0112939	A1	5/2007	Wilson et al.	
2007/0139214	A1	6/2007	Andersen et al.	
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2009/0326800	A1	12/2009	Kalaboukis et al.	
2010/0011377	A1	1/2010	Imai et al.	
2010/0019920	A1	1/2010	Ketari	
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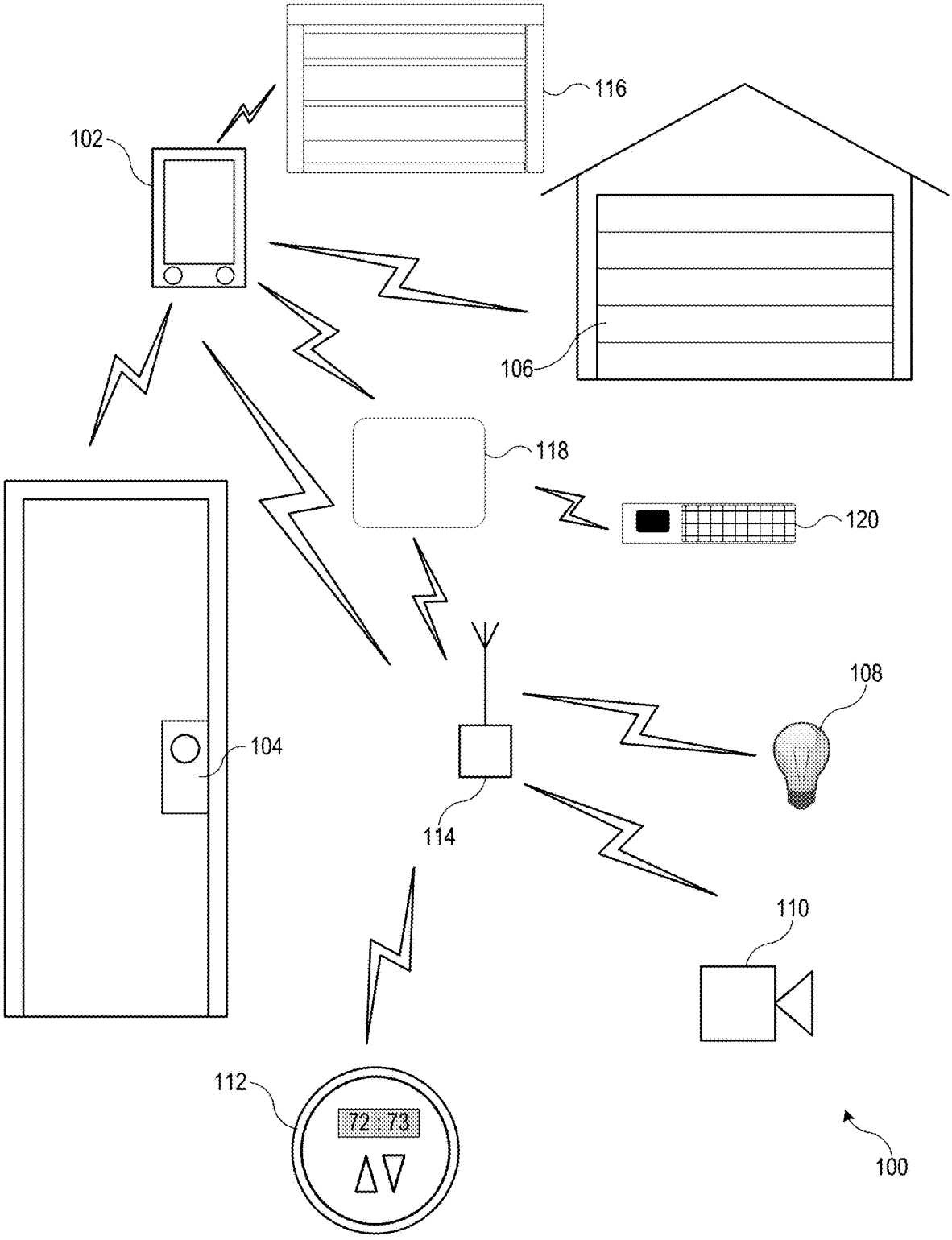

FIG. 1

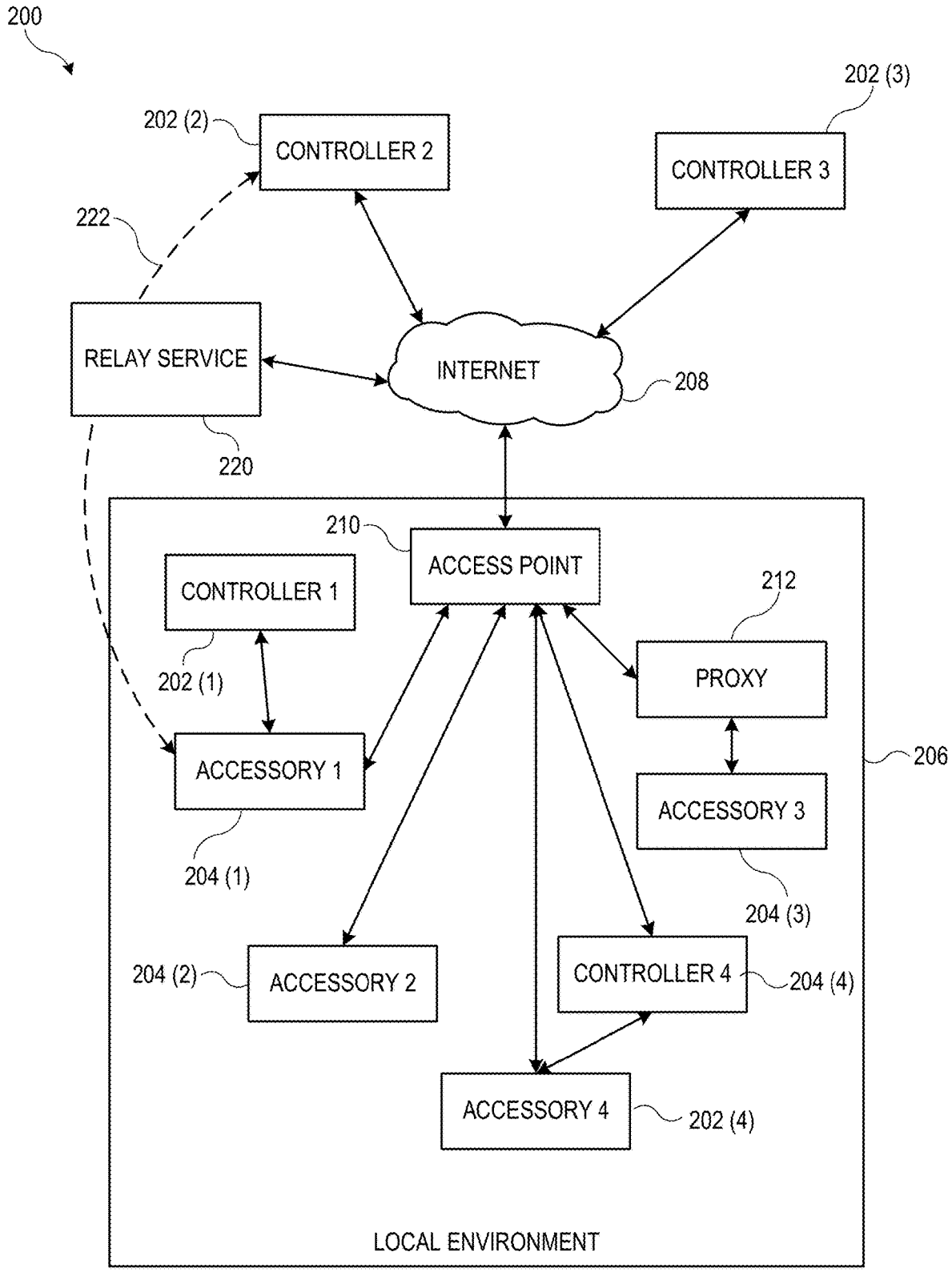
200
202 (3)
202 (2)
CONTROLLER 2
CONTROLLER 3
222
RELAY SERVICE
INTERNET
208
220
210
ACCESS POINT
CONTROLLER 1
212
PROXY
202 (1)
ACCESSORY 1
206
ACCESSORY 3
204 (1)
204 (3)
204 (2)
ACCESSORY 2
CONTROLLER 4
204 (4)
ACCESSORY 4
202 (4)
LOCAL ENVIRONMENT

FIG. 2

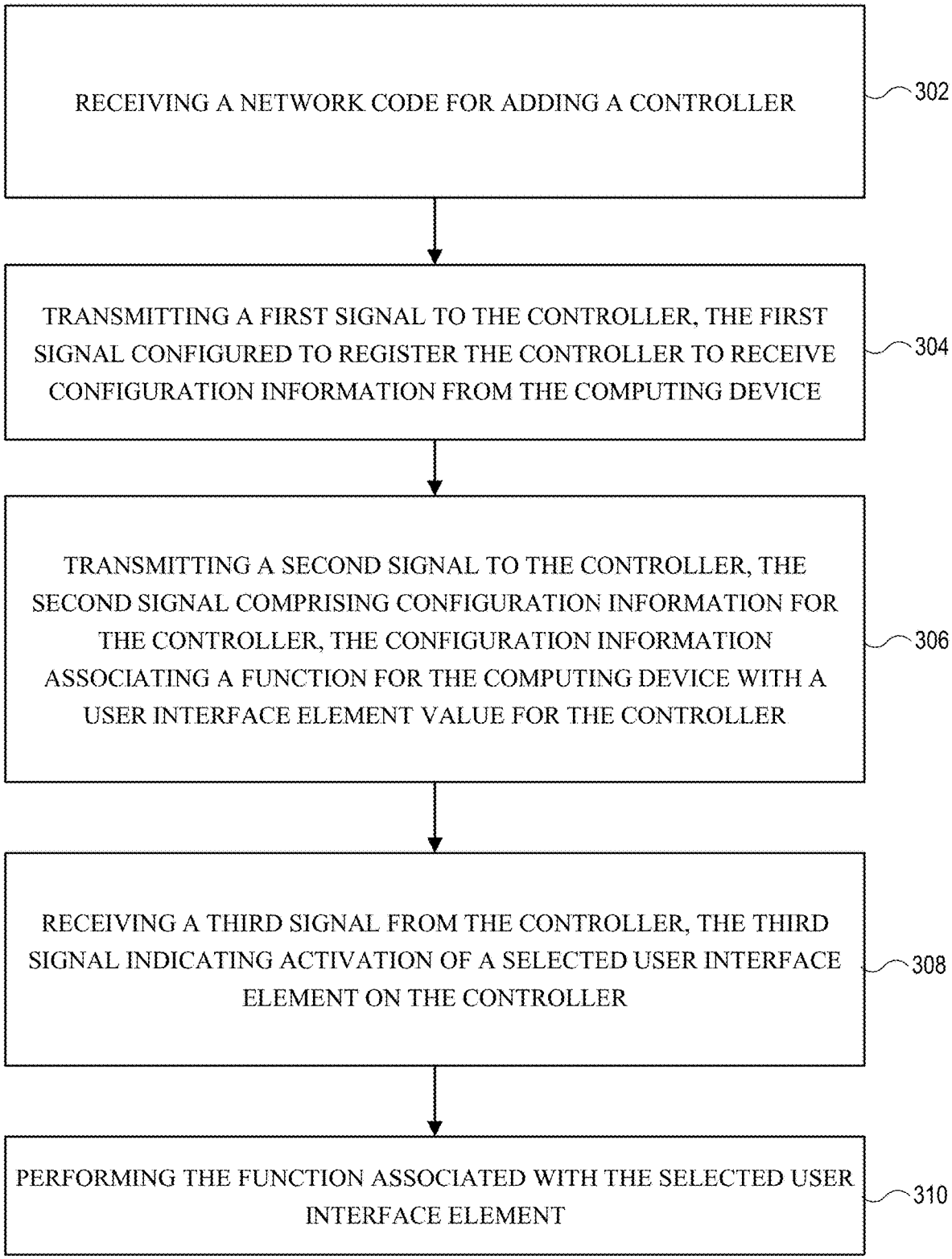
RECEIVING A NETWORK CODE FOR ADDING A CONTROLLER
302
TRANSMITTING A FIRST SIGNAL TO THE CONTROLLER, THE FIRST SIGNAL CONFIGURED TO REGISTER THE CONTROLLER TO RECEIVE CONFIGURATION INFORMATION FROM THE COMPUTING DEVICE
304
TRANSMITTING A SECOND SIGNAL TO THE CONTROLLER, THE SECOND SIGNAL COMPRISING CONFIGURATION INFORMATION FOR THE CONTROLLER, THE CONFIGURATION INFORMATION ASSOCIATING A FUNCTION FOR THE COMPUTING DEVICE WITH A USER INTERFACE ELEMENT VALUE FOR THE CONTROLLER
306
RECEIVING A THIRD SIGNAL FROM THE CONTROLLER, THE THIRD SIGNAL INDICATING ACTIVATION OF A SELECTED USER INTERFACE ELEMENT ON THE CONTROLLER
308
PERFORMING THE FUNCTION ASSOCIATED WITH THE SELECTED USER INTERFACE ELEMENT
310
300

FIG. 3

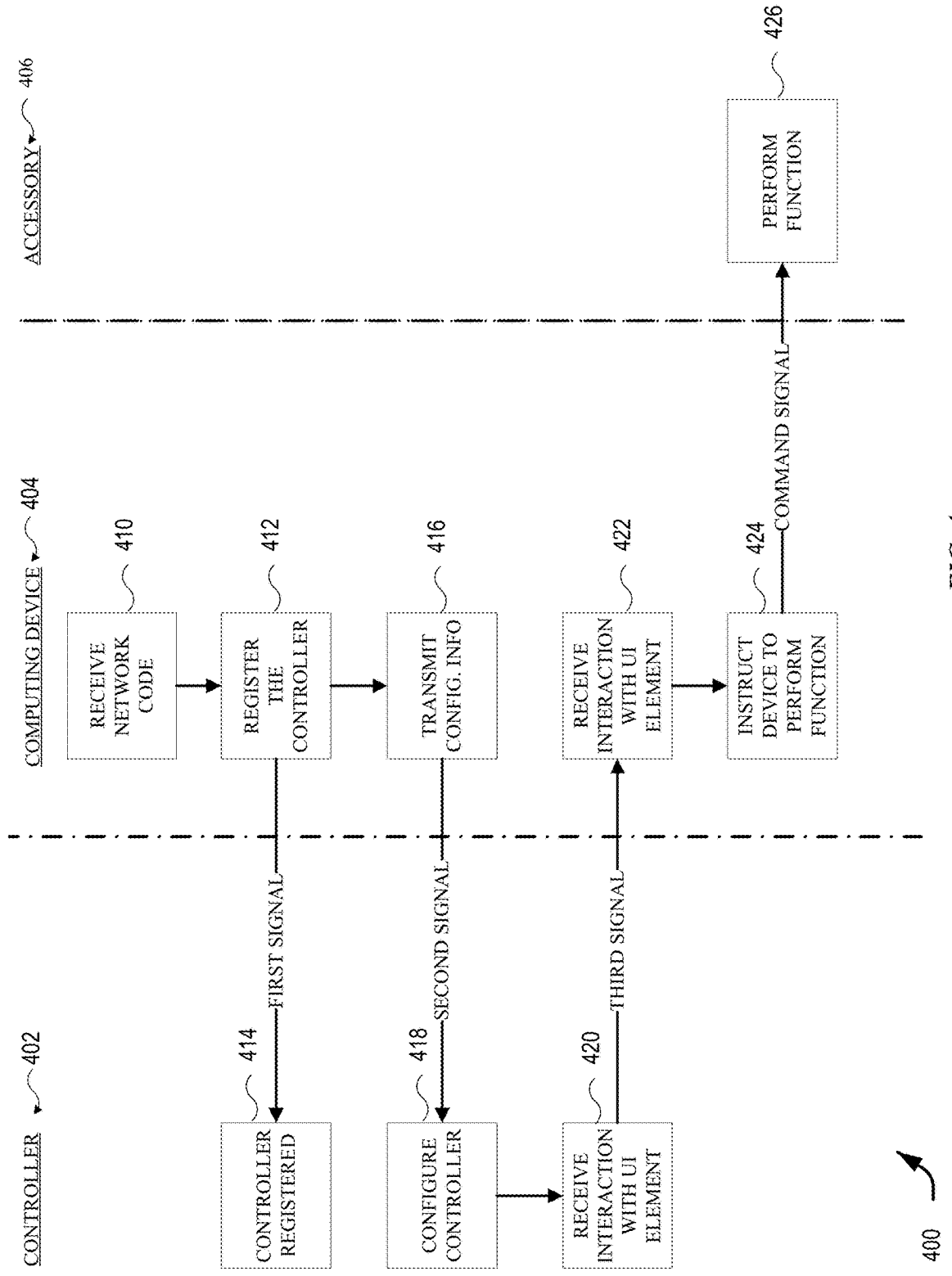
CONTROLLER
402
COMPUTING DEVICE
404
ACCESSORY
406
RECEIVE NETWORK CODE
410
REGISTER THE CONTROLLER
412
TRANSMIT CONFIG. INFO
416
RECEIVE INTERACTION WITH UI ELEMENT
422
INSTRUCT DEVICE TO PERFORM FUNCTION
424
PERFORM FUNCTION
426
COMMAND SIGNAL
FIRST SIGNAL
SECOND SIGNAL
THIRD SIGNAL
CONTROLLER REGISTERED
414
CONFIGURE CONTROLLER
418
RECEIVE INTERACTION WITH UI ELEMENT
420
400

FIG. 4

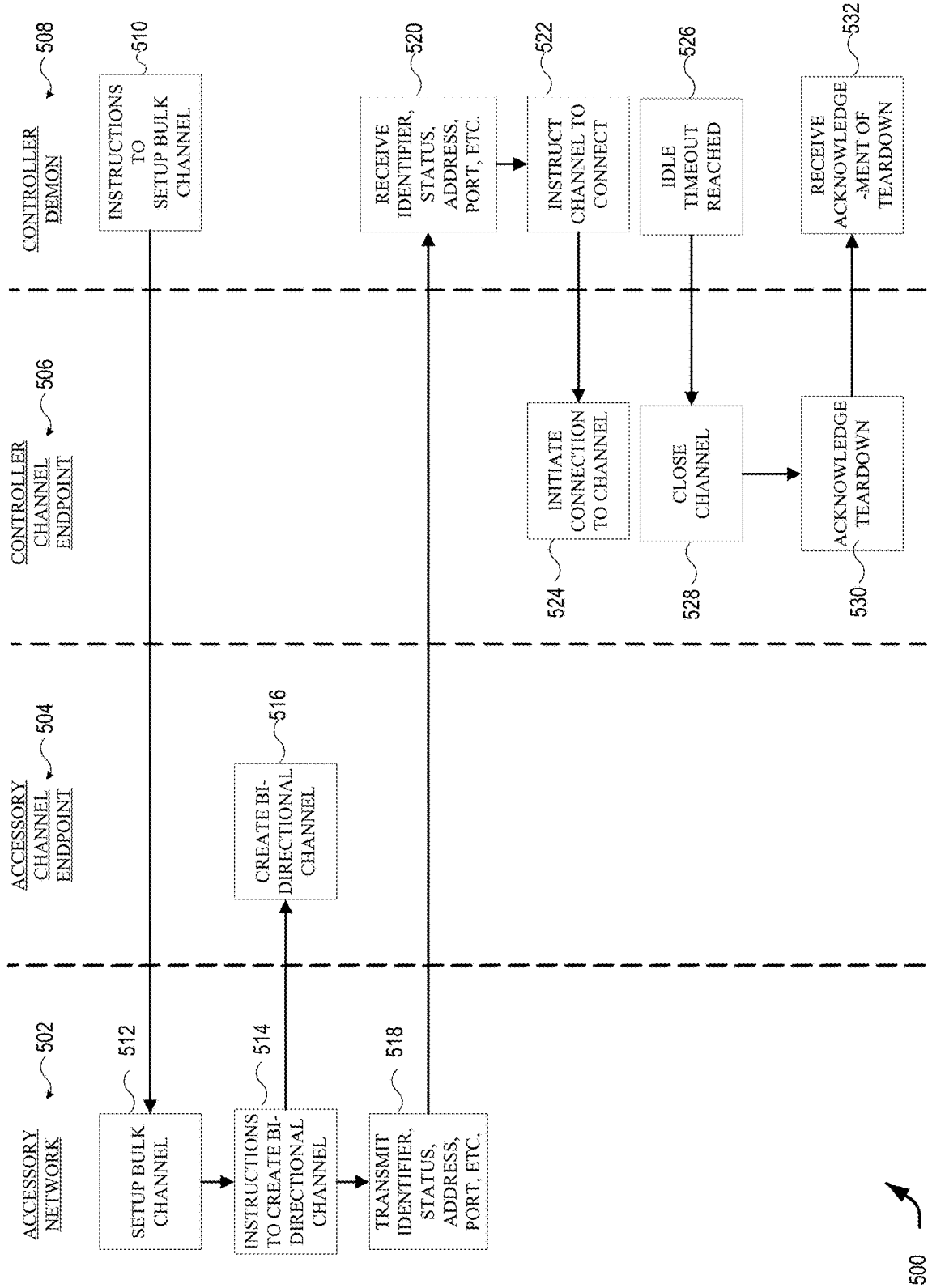
ACCESSORY NETWORK
502
ACCESSORY CHANNEL ENDPOINT
504
CONTROLLER CHANNEL ENDPOINT
506
CONTROLLER DEMON
508
SETUP BULK CHANNEL
512
INSTRUCTIONS TO SETUP BULK CHANNEL
510
INSTRUCTIONS TO CREATE BI-DIRECTIONAL CHANNEL
514
CREATE BI-DIRECTIONAL CHANNEL
516
TRANSMIT IDENTIFIER, STATUS, ADDRESS, PORT, ETC.
518
RECEIVE IDENTIFIER, STATUS, ADDRESS, PORT, ETC.
520
INSTRUCT CHANNEL TO CONNECT
522
INITIATE CONNECTION TO CHANNEL
524
IDLE TIMEOUT REACHED
526
CLOSE CHANNEL
528
ACKNOWLEDGE TEARDOWN
530
RECEIVE ACKNOWLEDGE-MENT OF TEARDOWN
532
500

FIG. 5

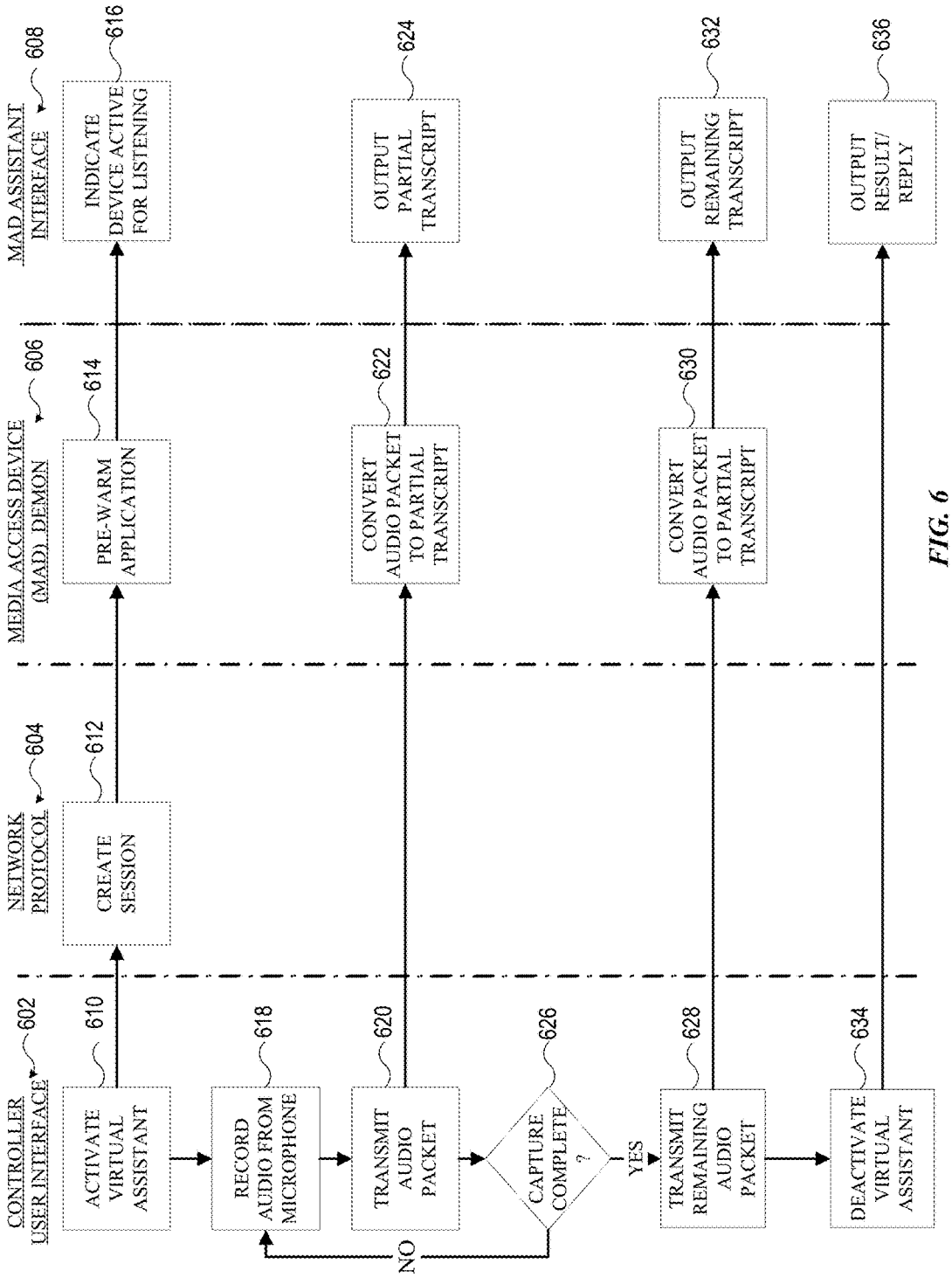
CONTROLLER USER INTERFACE
602
NETWORK PROTOCOL
604
MEDIA ACCESS DEVICE (MAD) DEMON
606
MAD ASSISTANT INTERFACE
608
ACTIVATE VIRTUAL ASSISTANT
610
CREATE SESSION
612
PRE-WARM APPLICATION
614
INDICATE DEVICE ACTIVE FOR LISTENING
616
RECORD AUDIO FROM MICROPHONE
618
TRANSMIT AUDIO PACKET
620
CONVERT AUDIO PACKET TO PARTIAL TRANSCRIPT
622
OUTPUT PARTIAL TRANSCRIPT
624
CAPTURE COMPLETE ?
626
NO
YES
TRANSMIT REMAINING AUDIO PACKET
628
CONVERT AUDIO PACKET TO PARTIAL TRANSCRIPT
630
OUTPUT REMAINING TRANSCRIPT
632
DEACTIVATE VIRTUAL ASSISTANT
634
OUTPUT RESULT/ REPLY
636
600

FIG. 6

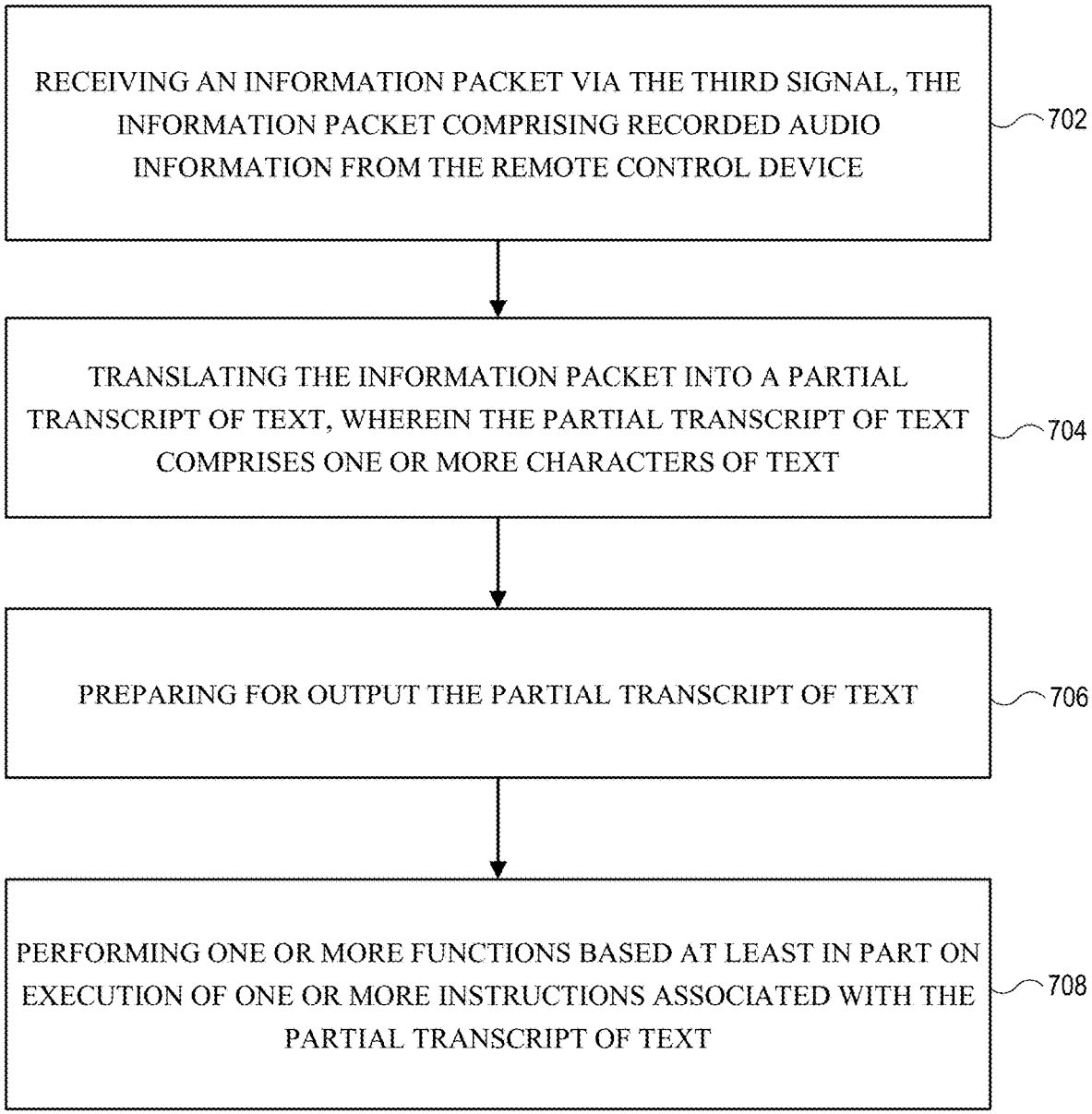
RECEIVING AN INFORMATION PACKET VIA THE THIRD SIGNAL, THE INFORMATION PACKET COMPRISING RECORDED AUDIO INFORMATION FROM THE REMOTE CONTROL DEVICE
702
TRANSLATING THE INFORMATION PACKET INTO A PARTIAL TRANSCRIPT OF TEXT, WHEREIN THE PARTIAL TRANSCRIPT OF TEXT COMPRISES ONE OR MORE CHARACTERS OF TEXT
704
PREPARING FOR OUTPUT THE PARTIAL TRANSCRIPT OF TEXT
706
PERFORMING ONE OR MORE FUNCTIONS BASED AT LEAST IN PART ON EXECUTION OF ONE OR MORE INSTRUCTIONS ASSOCIATED WITH THE PARTIAL TRANSCRIPT OF TEXT
708
700

FIG. 7

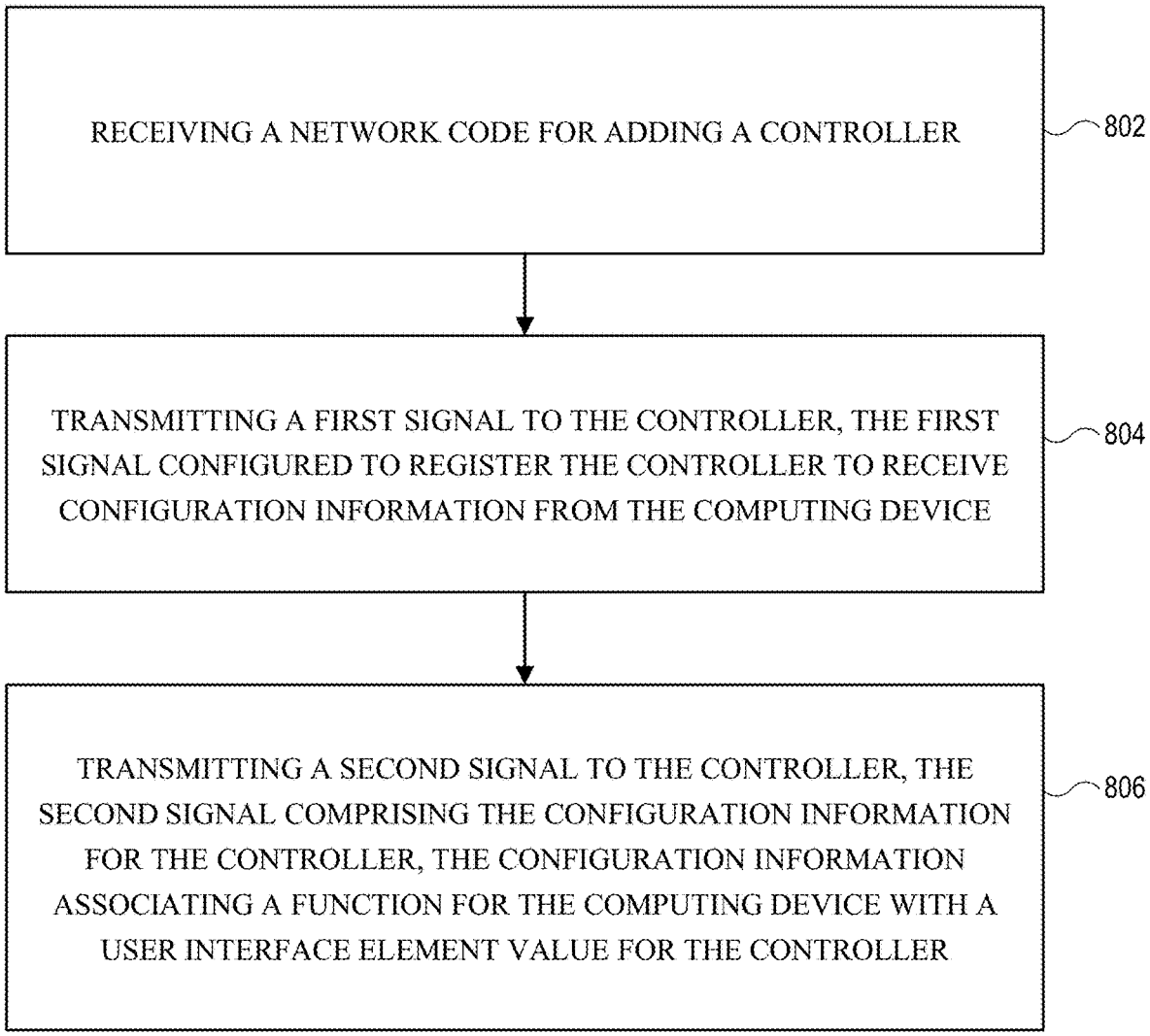
RECEIVING A NETWORK CODE FOR ADDING A CONTROLLER
802
TRANSMITTING A FIRST SIGNAL TO THE CONTROLLER, THE FIRST SIGNAL CONFIGURED TO REGISTER THE CONTROLLER TO RECEIVE CONFIGURATION INFORMATION FROM THE COMPUTING DEVICE
804
TRANSMITTING A SECOND SIGNAL TO THE CONTROLLER, THE SECOND SIGNAL COMPRISING THE CONFIGURATION INFORMATION FOR THE CONTROLLER, THE CONFIGURATION INFORMATION ASSOCIATING A FUNCTION FOR THE COMPUTING DEVICE WITH A USER INTERFACE ELEMENT VALUE FOR THE CONTROLLER
806
800

FIG. 8

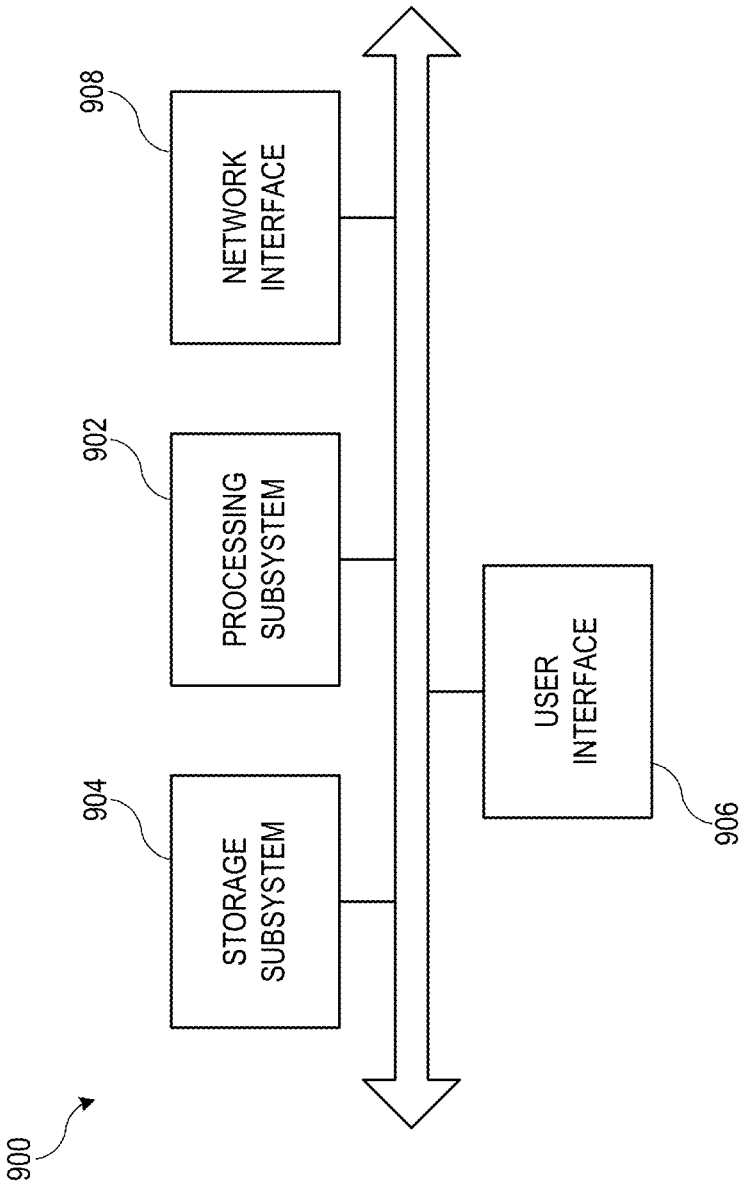
900
908
NETWORK INTERFACE
902
PROCESSING SUBSYSTEM
904
STORAGE SUBSYSTEM
USER INTERFACE
906

FIG. 9

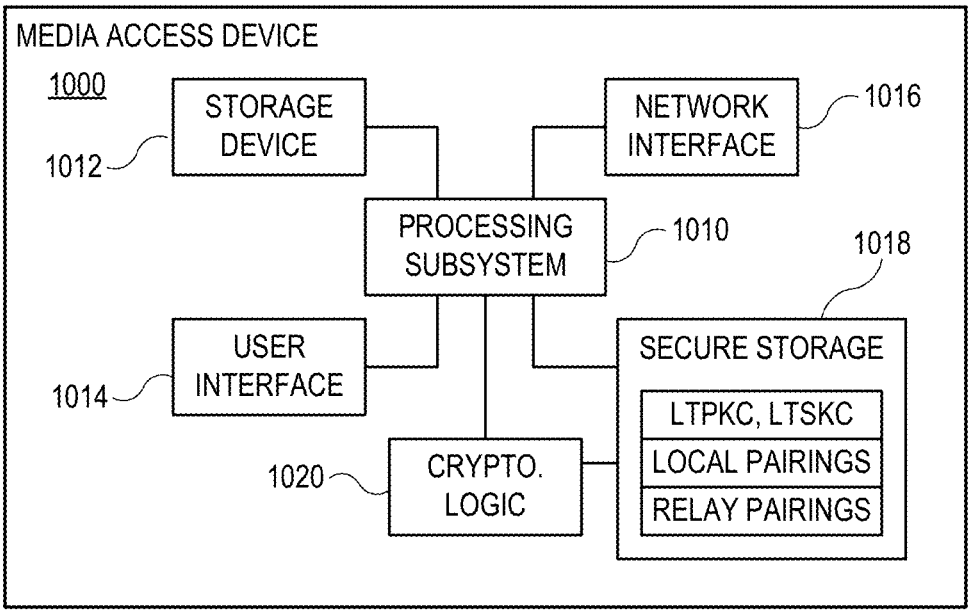
MEDIA ACCESS DEVICE
1000
STORAGE DEVICE
1012
NETWORK INTERFACE
1016
PROCESSING SUBSYSTEM
1010
1018
USER INTERFACE
1014
SECURE STORAGE
LTPKC, LTSKC
LOCAL PAIRINGS
RELAY PAIRINGS
1020
CRYPTO. LOGIC

FIG. 10

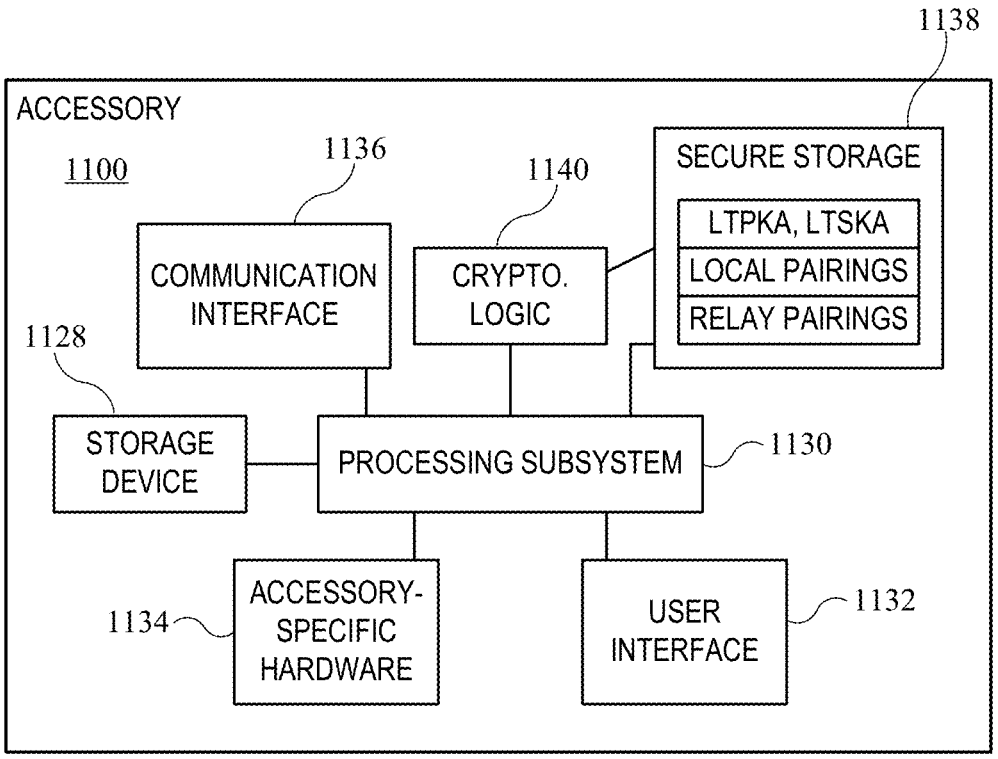
1138
ACCESSORY
1100
1136
1140
SECURE STORAGE
LTPKA, LTSKA
LOCAL PAIRINGS
RELAY PAIRINGS
COMMUNICATION INTERFACE
CRYPTO. LOGIC
1128
STORAGE DEVICE
PROCESSING SUBSYSTEM
1130
1134
ACCESSORY-SPECIFIC HARDWARE
USER INTERFACE
1132

FIG. 11

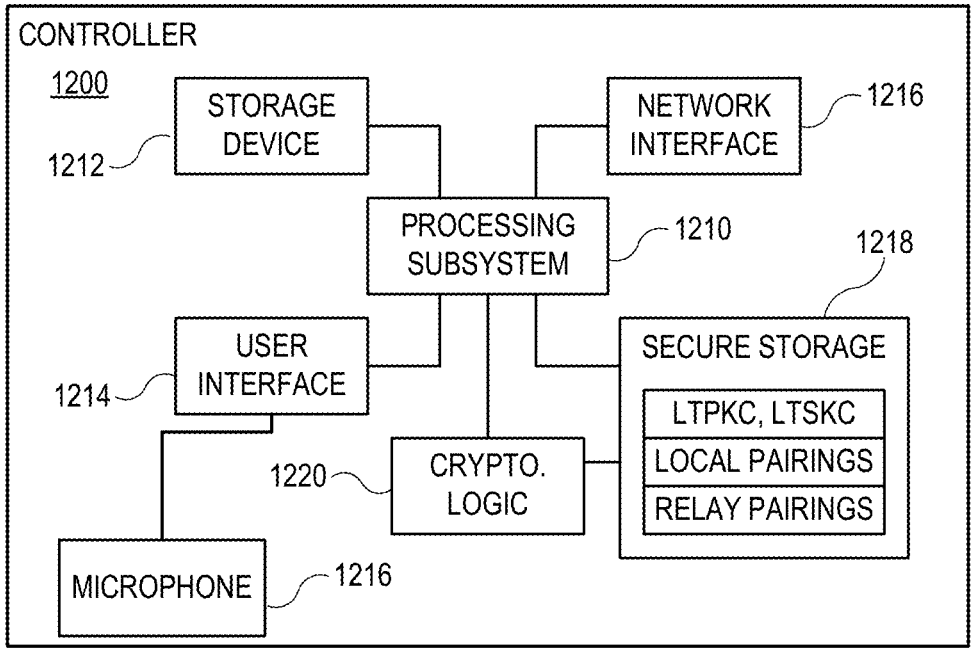
CONTROLLER
1200
STORAGE DEVICE
1212
NETWORK INTERFACE
1216
PROCESSING SUBSYSTEM
1210
1218
USER INTERFACE
1214
SECURE STORAGE
LTPKC, LTSKC
LOCAL PAIRINGS
RELAY PAIRINGS
1220
CRYPTO. LOGIC
MICROPHONE
1216

FIG. 12

TECHNIQUES FOR AUTHORIZING CONTROLLER DEVICES

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a Continuation of U.S. patent application Ser. No. 16/140,470, filed on Sep. 24, 2018, which claims priority to commonly-owned U.S. Provisional Application Ser. No. 62/679,922, filed Jun. 3, 2018 and entitled "Techniques for Authorizing Controller Devices," and hereby incorporates by reference the disclosure in its entirety and for all purposes. This application incorporates by reference commonly-owned U.S. patent application Ser. No. 15/064,406, filed Mar. 8, 2016, entitled, "Relay Service for Communications Between Controllers and Accessories," which claims priority to U.S. Provisional Application No. 62/171,995, filed Jun. 5, 2015, entitled "Relay Service for Communications Between Controllers and Accessories," the disclosures of which are hereby incorporated by reference in their entirety for all purposes.

The present disclosure is also related to the following U.S. patent applications: U.S. application Ser. No. 14/614,914, filed Feb. 5, 2015; U.S. application Ser. No. 14/725,891, filed May 29, 2015; and U.S. application Ser. No. 14/725,912, filed May 29, 2015. The disclosures of these applications are also incorporated by reference herein in their entirety for all purposes.

This application incorporates by reference commonly-owned U.S. patent application Ser. No. 62/575,373, filed Oct. 21, 2017, entitled "Personal Domain for a Virtual Assistant System on a Communal Device," in its entirety and for all purposes.

BACKGROUND

Many of the entertainment devices (e.g., televisions, digital media players, digital video disc, Blu-ray players, etc.) used in homes utilize remote controls. Other non-entertainment devices such as blinds, lights, garage doors, thermostats, etc., also utilize remote controls. The amount of remote control devices required to control all of these devices can result in clutter and an overall poor user experience. Often, sitting down to watch TV or a movie requires shuffling between several remotes, switching inputs, and powering-on multiple components at the same time. Controllers can be configured to control multiple devices. Therefore, homeowners need to retain several remote devices to control these devices, resulting in clutter and an overall poor user experience.

SUMMARY

Embodiments of the present disclosure can provide devices, methods, and computer-readable medium for enabling controller devices to control proprietary digital media players, home network accessories, and virtual assistants, providing an overall improved user experience. The techniques disclosed herein reduce clutter and improve efficiency for home networking because a single controller can control various different accessories.

In various embodiments, the technique for accessory control can include receiving, by a computing device for a home network, a network code for adding a controller. The network code can be entered by a user via a user interface of an application for the home network. The technique for accessory control can include transmitting, by the computing device, a first signal to the controller, the first signal configured to register the controller to receive configuration information from the computing device. The technique for accessory control can include transmitting, by the computing device, a second signal to the controller, the second signal comprising the configuration information for the controller, the configuration information associating a function for the computing device with a user interface element value for the controller. The technique for accessory control can include receiving, by the computing device, a third signal from the controller, the third signal indicating activation of a selected user interface element on the controller. The technique for accessory control can include performing, by the computing device, the function associated with the selected user interface element.

In various embodiments, the technique for accessory control can include receiving, by the computing device, information (e.g., an information packet) via the third signal. The information packet can include recorded audio information from the controller. The technique for accessory control can include translating, by the computing device, the information packet into a partial transcript of text, where the partial transcript of text includes one or more characters of text. The technique for accessory control can include preparing for display, at the computing device, the partial transcript of text. The technique for accessory control can include performing, by the computing device, one or more functions based at least in part on execution of one or more instructions associated with the partial transcript of text. The technique can include displaying the partial transcript of text.

In various embodiments, the technique for accessory control can include identifying, by the computing device, a change in the configuration information for the computing device. The technique for accessory control can include transmitting, by the computing device, a fourth signal that includes revised configuration information for associating functions of the computing device with the user interface element value for the controller.

In various embodiments, the technique for accessory control can include authorizing the controller to control one or more accessories of various types that are wirelessly connected to the computing device.

In various embodiments, the technique for accessory control can include synchronizing the control of the one or more accessories such that a command from the controller will perform a related function for each of a same type of accessory.

In various embodiments, the technique for accessory control can include causing an interface of the controller to display representations of the one or more accessories on a display of the controller.

In various embodiments, the technique for accessory control can include receiving, from the controller, authorization for the computing device to control one or more accessories of various types that are wirelessly connected to the controller. The technique can include synchronizing the control of the one or more accessories such that a command from the computing device will perform a related function for each of a same type of accessory. The technique can include providing an interface for a user to select the one or more accessories on the computing device.

In various embodiments, the technique for accessory control can include receiving, by the computing device, a request from the controller to open a channel. In some embodiments, the channel can be bi-directional. The technique can include opening, by the computing device, the

channel for reception of the third signal containing digital audio data. The technique can include transmitting, by the computing device, a fifth signal to the controller, the fifth signal including a transmit identifier, a status, an address, and a channel identifier. The technique can include receiving, by the computing device, an information packet via the third signal, the information packet including digital audio data from the controller.

In various embodiments, the techniques for accessory control can be stored as a plurality of instructions in a computer readable medium.

In various embodiments, the techniques for accessory control can be incorporated in a computing device, including one or more memories, and one or more processors in communication with the one or more memories and configured to execute instructions stored in the one or more memories.

The following detailed description together with the accompanying drawings will provide a better understanding of the nature and advantages of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a network environment according to an embodiment of the present disclosure.

FIG. **2** illustrates a network configuration according to an embodiment of the present disclosure.

FIG. **3** illustrates a simplified flow diagram for a technique for authorizing universal devices according to an embodiment of the present disclosure.

FIG. **4** illustrates a diagram for a technique for authorizing universal devices according to an embodiment of the present disclosure.

FIG. **5** illustrates a simplified flow diagram for a technique for opening a channel according to another embodiment of the present disclosure.

FIG. **6** illustrates a simplified flow diagram for a technique for enabling a controller device access a virtual assistant according to an embodiment of the present disclosure.

FIG. **7** illustrates another simplified flow diagram for a technique enabling a controller device access a virtual assistant an embodiment of the present disclosure.

FIG. **8** illustrates a simplified flow diagram for instructions in a computer readable medium for accessory control according to an embodiment of the present disclosure.

FIG. **9** illustrates a simplified block diagram of a computer system according to an embodiment of the present disclosure.

FIG. **10** illustrates a simplified block diagram of a media access device according to an embodiment of the present disclosure.

FIG. **11** illustrates a simplified block diagram of an accessory according to an embodiment of the present disclosure.

FIG. **12** illustrates a simplified block diagram of a controller according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

Certain embodiments of the present disclosure relate to devices, computer-readable medium, and methods for implementing various techniques for controlling accessories. In the following description, various embodiments will be described. For purposes of explanation, specific configurations and details are set forth in order to provide a thorough understanding of the embodiments. However, it will also be apparent to one skilled in the art that the embodiments may be practiced without the specific details. Furthermore, well-known features may be omitted or simplified in order not to obscure the embodiment being described. The present disclosure describes devices and methods for enabling controller device to control proprietary digital media players, network accessories, and virtual assistants.

I. Example Environment

FIG. **1** shows a network environment **100** according to an embodiment of the present disclosure. In some embodiments, the network environment **100** can be a home network. Network environment **100** includes a controller **102** that can communicate with various accessory devices (also referred to as accessories) located in the environment. Controller **102** can include, for example, a desktop computer, laptop computer, tablet computer, smart phone, wearable computing device, personal digital assistant, or any other computing device or set of devices that can be capable of communicating command-and-control messages to accessories (e.g., as described in above-referenced U.S. application Ser. No. 14/614,914) and presenting a user interface to allow a user to indicate desired operations on the accessories. In some embodiments, controller **102** can be implemented using multiple discrete devices. For example, there can be a base station that communicates with accessories and that can be installed in a fixed location in environment **100**, and one or more mobile remote-control stations (e.g., a handheld or wearable device such as a mobile phone, tablet computer, smart watch, eyeglasses, etc.) that provide a user interface and communicate with the base station to effect control over accessories. In some embodiments, the base station can function as a coordinator or proxy as described in above-referenced U.S. application Ser. No. 14/725,891.

Any type of accessory device can be controlled. Examples of accessory devices include door lock **104**, garage door system **106**, light fixture **108**, security camera **110**, and thermostat **112**. In some instances, controller **102** can communicate directly with an accessory; for instance, controller **102** is shown communicating directly with door lock **104**, garage door system **106**, and window blinds **116**. In other instances, controller **102** can communicate via an intermediary. For instance, controller **102** is shown communicating via a wireless network access point **114** with accessories such as **108**, **110**, **112**, **118** that are on a wireless network provided by access point **114**. As noted above, in some embodiments, controller **102** can include a base station, and base station functionality can be integrated into access point **114** or into one of the accessories that is to be controlled (e.g., thermostat **112**). In some embodiments, an intermediary can function as a proxy or coordinator as described in above-referenced U.S. application Ser. No. 14/725,891. In some embodiments, the controller can control a media access and media access device **118**. In some embodiments, the media access device **118** can provide access to multimedia content in addition to providing support as a hub for a home network. In some embodiments the media access device can have a separate proprietary controller **120**.

Various communication transports and combinations of transports can be used, and different transports can be used with different devices. For example, some wireless transports such as the Bluetooth® Classic or Bluetooth® Smart communication protocol and standards promulgated by the Bluetooth SIG (referred to herein as "Bluetooth" and "Bluetooth LE") can support direct point-to-point communication between devices within a limited range. Other wireless transports such as a wireless network complying with Wi-

Fi® networking standards and protocols promulgated by the Wi-Fi Alliance (referred to herein as a "Wi-Fi network") can define a wireless network with a central access point that can facilitate communications between different devices on the network. Further, while wireless communication transports are shown, wired transports can also be provided for some or all of the accessories. For example, light bulb **108** can be connected to access point **114** by a wired connection, and controller **102** can communicate with light bulb **108** by sending messages wirelessly to access point **114**, which can deliver the messages to light bulb **108** via the wired connection. Other combinations of wired and wireless communication are also possible.

Further, while one controller **102** is shown, the network environment can have multiple associated controller devices. In various embodiments, controller **102** is a universal controller able to be programmed to control one or more devices or accessories from various manufacturers. In some embodiments, controller **102** can include a liquid crystal display (LCD) touch-screen displays. Some LCD touch screens include "virtual buttons" on the display of the remote. In some embodiments, the user interface elements (buttons) on the device can be programmed and reprogrammed to perform other functions. In some embodiments, the display of the controller **102** can register physical gestures of a user. In some embodiments, the controller **102** contains one of more accelerometer or gyrometer to detect movement of the controller. Some embodiments of controllers allow for changing the configuration of how the virtual buttons are displayed on the controller **102**. In some embodiments, the controller **102** can use radio frequency waves to operate devices in which obstacles block a traditional infrared signal. A controller **102** using radio frequency waves can be used to control electronics in the next room.

Many controller devices claim to use Bluetooth for universal control accessories. However, often what actually occurs is that the controller devices send a Bluetooth signal to a hub. The hub incorporates an infrared blaster that sends out the remote control command signals via infrared from the blaster. These communications are also a one-way communication channel from the controller device or the hub to the device. For traditional universal controllers, the remote knows what function the user is commanding when a user interface element is activated. The controller described in the present disclosure is open ended because the controller does not have the knowledge about the activation. In some embodiments, the technique includes authorizing the controller to control one or more accessories of various types that are wirelessly connected to the computing device.

In some embodiments, the universal controller may be a high-end controller such as one manufactured by Savant Systems LLC, Logitech, Elan Home Systems, Crestron Electronics, Inc., and Control4 Corporation. However, the controllers listed are merely an example, the present disclosure is not limited to any one of these systems. In the present disclosure, the communication between the controller and the device can be bi-directional. Therefore, the accessory or device can send information the controller **102**.

In some embodiments, a uniform accessory protocol can facilitate communication by a controller **102** with one or more accessories **104-116**. The uniform accessory protocol can provide a simple and extensible framework that models an accessory as a collection of services, with each service being defined as a set of characteristics, each of which has a defined value at any given time. Various characteristics can represent various aspects of the accessory's state. For example, in the case of thermostat **112**, characteristics can include power (on or off), current temperature, and target temperature. In some embodiments, message formats may be transport-dependent while conforming to the same accessory model. An accessory can provide an "attribute database" that identifies the services and characteristics that the accessory exposes to controllers. A controller **102** can read the attribute database (or a portion thereof) from an accessory and use the attribute database to determine how to interact with the accessory. Examples of an accessory model based on services and characteristics are described in above-referenced U.S. application Ser. No. 14/614,914.

The uniform accessory protocol can further define message formats for controller **102** to send command-and-control messages (requests) to an accessory (or other accessories) and for an accessory to send response messages to controller **102**. The command-and-control messages can allow controller **102** to interrogate the current state of accessory characteristics (e.g., by sending a read request) and in some instances to modify the characteristics (e.g., sending a request to write to the power characteristic can result in turning an accessory off or on). Accordingly, any type of accessory, regardless of function or manufacturer, can be controlled by sending appropriate messages. The message format can be the same across accessories of disparate types. Examples of message formats are described in above-referenced U.S. application Ser. No. 14/614,914.

The uniform accessory protocol can further provide notification mechanisms that allow an accessory (or other accessories) to selectively notify controller **102** in the event of a state change. Multiple mechanisms can be implemented, and controller **102** can register, or subscribe, for the most appropriate notification mechanism for a given purpose. Examples of notification mechanisms are described in above-referenced U.S. application Ser. No. 14/614,914.

In some embodiments, communication with a given accessory can be limited to controllers that have received authorization. For instance, the uniform accessory protocol can specify one or more mechanisms (including mechanisms referred to herein as "pair setup" and "pair add") for establishing a "pairing" (also referred to herein as a "local pairing") between controller **102** and a given accessory (e.g., door lock accessory) under circumstances that provide a high degree of confidence that the user intends for controller **102** to be able to control accessory. Pair setup can include an out-of-band information exchange (e.g., the user can enter a numerical or alphanumeric PIN or passcode provided by accessory into an interface provided by controller **102**) to establish a shared secret. This shared secret can be used to support secure exchange of "long-term" public keys between controller **102** and accessory, and each device can store the long-term public key received from the other, so that an established pairing can be persistent. After a local pairing is established, controller **102** is considered authorized, and thereafter, controller **102** and accessory can go in and out of communication as desired without losing the established pairing. When controller **102** attempts to communicate with or control accessory, a "pair verify" process specified by the uniform accessory protocol can first be performed to verify that an established local pairing exists (as would be the case, e.g., where controller **102** previously completed pair setup with accessory). The pair verify process can include each device demonstrating that it is in possession of a long-term private key corresponding to the long-term public key that was exchanged during pair setup and can further include establishing a new shared secret or session key to encrypt all communications during a "pair-verified" session, (also referred to herein as a verified

session). During a pair-verified session, a controller that has appropriate privileges can perform a "pair add" process to establish another pairing with the accessory on behalf of another controller. Either device can end a pair-verified session at any time simply by destroying or invalidating its copy of the session key.

In some embodiments, multiple controllers can establish a local pairing with the same accessory (e.g., by performing pair setup or by having a pairing added by a controller that previously performed pair setup), and the accessory can accept and respond to communications from any of its paired controllers while rejecting or ignoring communications from unpaired controllers. Examples of pair setup, pair add and pair verify processes, as well as other examples of security-related operations, are described in above-referenced U.S. application Ser. No. 14/614,914. In some embodiments of the present disclosure, additional "relay pairing" processes can be defined and used to allow controllers to communicate with accessories via a relay service external to the local environment.

It will be appreciated that home environment **100** is illustrative and that variations and modifications are possible. Embodiments of the present disclosure can be implemented in any environment where a user wishes to control one or more accessory devices using a controller device, including but not limited to homes, cars or other vehicles, office buildings, campuses having multiple buildings (e.g., a university or corporate campus), etc. A single controller can establish pairings with any number of accessories and can selectively communicate with different accessories at different times. Similarly, a single accessory can be controlled by multiple controllers with which it has established pairings. Any function of an accessory can be controlled by modeling the function as a service having one or more characteristics and allowing a controller to interact with (e.g., read, modify, receive updates) the service and/or its characteristics. Accordingly, protocols and communication processes used in embodiments of the disclosure can be uniformly applied in any context with one or more controllers and one or more accessories, regardless of accessory function or controller form factor or specific interfaces.

II. Network Configuration

FIG. **2** shows a network configuration **200** according to an embodiment of the present disclosure. Configuration **200** allows controllers **202** to communicate with accessories **204** located in local environment **206** (e.g., a home environment such as environment **100** described above). Each controller **202** can be an electronic device owned and/or operated by a user who frequents environment **206** (e.g., a resident of a home or a regular visitor to the home). Controllers **202** can each be similar to controller **102** of FIG. **1**, and accessories **204** can be similar to various accessories shown in FIG. **1**.

In various embodiments, accessories **204** can each communicate with an access point **210** that can be located in local environment **206**. Access point **210** can provide a local area network (LAN) to which accessories **204** and controllers **202** (when present in local environment **206**) can connect. Any type of LAN technology can be used, including Wi-Fi networks or other wireless LAN technologies. Thus, access point **210** can facilitate communication between accessories **204** and controllers **202** within local environment **206**. In some embodiments, a controller (e.g., controller **202**(**1**)) that is present in local environment **206** can communicate directly with an accessory (e.g., accessory **204**(**1**)). Bluetooth communication, ad hoc wireless networking, or other point-to-point communication technologies can be used as desired.

In some instances, an accessory might not communicate directly with access point **210** or with controllers **202**. For example, accessory **204**(**3**) can be connected to a proxy **212**, and controllers **202** and/or access point **210** can communicate with accessory **204**(**3**) via proxy **212**. In various embodiments, proxy **212** can provide relaying of messages to and from accessory **204**(**3**). Proxy **212** can implement communication security measures and/or protocol translation, and a single proxy **212** can interface to one or more accessories **204**. In some embodiments, proxy **212** can be an "intelligent" device that can coordinate operations among multiple controllers and/or accessories and is not limited to passively relaying messages. Specific examples of proxy devices that can be implemented as proxy **212** (including devices referred to variously as bridges, tunnels, and coordinators) are described in above-referenced U.S. application Ser. No. 14/725,891.

In some embodiments, accessories **204** and controllers **202** that are present in local environment **206** can communicate using a local area network (LAN), such as a Wi-Fi network and/or a point-to-point communication medium such as Bluetooth LE. It is to be understood that other communication transports and protocols can be used. In some embodiments, controllers **202** and accessories **204** (and proxy **212** if present) can support a uniform accessory protocol as described above that can be implemented using both Wi-Fi and Bluetooth LE as transports.

In the example of FIG. **2**, controller **202**(**1**) is currently located in local environment **206** with accessories **204** and access point **210**. For example, controller **202**(**1**) can be on the same LAN as accessories **204**. Controllers **202**(**2**) and **202**(**3**) are currently located outside local environment **206** but are connected to a communication network **208** (e.g., the Internet); such controllers are said to be "remote" from accessories **204**. It is to be understood that controllers **202** can be mobile devices that are sometimes within local environment **206** and sometimes outside local environment **206**. Accessories **204** need not be mobile and need not be connected to communication network **208**. In some embodiments, access point **210** can be connected to communication network **208** (e.g., access point **210** can be implemented as a conventional Wi-Fi access point or base station) and can permit remote access to accessories **204** by remote controllers **202**(**2**) and **202**(**3**).

However, it may not be desirable to configure each of accessories **204** as a wide-area network device that can be found and communicated with by any device able to connect to communication network **208**. For instance, if communication network **208** is the Internet, a vast number of devices, including devices owned by anyone anywhere in the world, may be able to locate accessories **204** and attempt operations for which they are not authorized. Thus, to more selectively allow controllers **202** to communicate with accessories **204** via network **208**, it may be useful to employ a relay service **220**.

According to various embodiments of the present disclosure, relay service **220** can facilitate communication between controllers **202** (in particular remote controllers **202**(**2**), **202**(**3**)) and accessories **204** via communication network **208**. For example, relay service **220** can establish a persistent connection to accessory **204**(**1**), in which accessory **204**(**1**) is identified by a persistent accessory alias (also referred to as an "accessory relay alias," or "accessory RA") that is assigned by relay service **220** and known to controllers **202** (but presumably not to other devices that are not authorized to access accessories **204**). Controller **202**(**2**) can send a request to relay service **220** to deliver a message to

accessory **204(1)**; the request can include the message content, the accessory alias assigned to accessory **204(1)** by relay service **220**, and additional information (e.g., an access token as described below) usable by relay service **220** to verify that controller **202(2)** is authorized to communicate with accessory **204(1)**. Relay service **220** can deliver the message to accessory **204(1)**. Response messages from accessory **204(1)** can be delivered to controller **202(2)** in a similar manner, using a persistent operator alias (also referred to as an "operator relay alias," or "operator RA") that is assigned to controller **202(2)** by relay service **220** and known to accessory **204(1)** but presumably not to devices that are not authorized to use relay service **220** to communicate with controller **202(2)**. The message content exchanged between controller **202(2)** and accessory **204(1)** via relay service **220** can conform to a uniform accessory protocol as described above, and message content can be opaque to relay service **220**. Accordingly, controller **202(2)** and accessory **204(1)** can communicate via relay service **220** to establish a pair-verified session (as defined above) and can encrypt message content such that the message content is not readable by relay service **220** or any other intermediary through which the message content may pass. In this manner, relay service **220** can provide a secure end-to-end communication path (indicated by dashed line **222**) between controller **202(2)** and accessory **204(1)** (or between any controller **202** and any accessory **204**).

In some embodiments, controllers **202** can be configured to communicate with accessories **204** without using relay service **220** when possible. For example, when controller **202(2)** determines that it should send a message to accessory **204(1)** (e.g., based on user input or a received notification as described below), a communication daemon or other process executing in controller **202(2)** can determine whether "local access" (or a "local channel") to accessory **204(1)** is currently available. For instance, controller **202(2)** can actively or passively scan for the presence of accessory **204(1)** on a local network or point-to-point communication technology; if accessory **204(1)** is detected, then local access is possible. If accessory **204(1)** is not detected, then local access is not available and controller **202(2)** can communicate with relay service **220** instead. The determination whether to use local access or relay service **220** can be transparent to the user and can be made each time a communication channel to the accessory is to be established. Thus, a user who wants to interact with accessory **204(1)** using controller **202(2)** can simply do so without worrying about whether to use local access or remote access via relay service **220**.

In some embodiments, controller **204** (**4**) can be a proprietary controller device programmed to control one or more accessory **202** (**4**). The controller **204(4)** can be added to the network with procedures similar for adding other accessories to the network. In some embodiments, the controller **204(4)** can operate in the local environment and control accessory **204(1)**, **204(2)**, and **204(3)** through an access point **210**. In some embodiments, the proprietary accessory **202(4)** can be controlled by controllers **202(2)** and **202(3)** from outside the local environment.

It will be appreciated that network configuration **200** is illustrative and that variations and modifications are possible. Any number of controllers and any number of accessories can be included in a network configuration. In some embodiments, the network configuration can include one or more proxies (e.g., bridges, tunnels, coordinators as described in above-referenced U.S. application Ser. No. 14/725,912). Some or all of accessories **204** may be accessible only within the local environment. Further, as described below, different controllers **202** may have different levels of permission in regard to accessing accessories **204**; for instance, remote access via network **208** may be permitted for some controllers **202** but not for other controllers **202**.

III. Setup

FIG. **3** illustrates a simplified flow diagram for a technique for authorizing universal devices according to an embodiment of the present disclosure. A controller can be added to the network in a similar manner as other accessories. The technique for adding a controller can include receiving, at **302**, by a computing device for a network, a network code for adding a controller. In some embodiments the network code identified via a user interface of an application for the network. In some embodiments, the network can be a home network. Alternatively, the computing device can be referred to a hub computing device, or a host computing device. In some embodiments, the computing device can be the media access device **118**, shown in FIG. **1**.

In some embodiments, adding a controller to a network involves pairing the devices. Pairing establishes a cryptographic relationship between the media access device **118**, shown in FIG. **1**, and the controller **102**. There can be two components to pairing: pair setup and pair verify. Pair setup is a one-time operation that creates a valid pairing between the media access device **118** and an accessory or a controller **102** by securely exchanging public keys with the media access device **118** and the accessory or the controller **102**. Pair setup requires a user to enter a network code. The network code can be a numeric or alpha-numeric code of varying length (e.g., an eight-digit network code.) In various embodiments, the network code can be provided by the accessory or the controller **102** via a label or display on the device, packing materials, or instructions for the device.

In some embodiments, a machine-readable code such as a barcode or a Quick Response (QR) code can contain the network code. In some embodiments, the machine-readable code can be printed on the label for the accessory or the controller. In these embodiments, entering the network code can be established by scanning the machine-readable code with a device capable of reading the machine-readable code. In some embodiments, controllers can be smartphones or tablets with digital imaging devices (e.g., a camera) that are capable of reading the machine-readable code.

In some embodiments, the media access device **118**, shown in FIG. **1**, can be controlled through an application on a smartphone, a tablet, a laptop, or other computing device. Various applications (Apps for short) can be developed to control the interaction between the media access device **118**, accessories, and controllers. The application can provide a user interface which allows a user to manually enter the network code. In some embodiments, the network code can be entered through a keyboard or keypad. In some embodiments, the network code can be entered via a virtual keyboard. In some embodiments, the application can enable a user to scan the machine-readable code with a camera on the device executing the application. Scanning the machine-readable code can capture the network code in the application.

The pair verify process can be performed prior to any networking protocol session. Pair verify verifies the pairing between a computing device, and a controller or an accessory. Pair verify establishes an ephemeral shared secret to secure the networking protocol session.

The technique for adding a controller can include, transmitting, at **304**, by the computing device, a first signal to the

controller, the first signal configured to register the controller to receive configuration information from the computing device. The first signal can be a wired or wireless signal. The controller can receive the first signal and establish a link between the computing device and the controller **102**.

At **306**, the technique includes transmitting, by the computing device, a second signal to the controller, the second signal including the configuration information for the controller, the configuration information associating a function for the computing device with a user interface element value for the controller. The second signal can be a wired or wireless signal. Unlike traditional universal controllers which rely on selecting a variety of infrared (IR) codes for a specific device, the techniques disclosed herein involve transmitting a configuration from the computing device to the controller **102**. In this way, the configuration can change as the features on the media access device **118** changes.

After one or more controllers and media access device are added to the network, a network daemon and framework provide interface to manage the association of media access and networking device **118** with the controllers. Different network clients such as a home networking application or television settings application these interfaces to provide a user interface (UI) for user to manage these associations. When an media access networking device **118** is associated with a controller **102**, the network daemon making this association will configure the controller **102** with the configuration for the user interface elements so that the controller **102** can generate events to any interested controllers. The user interface elements can also be referred to as buttons. The network daemon on the media access device **118** that has been associated with the controller **102** can register for notifications on the Active Identifier networking protocol characteristic in the accessory control network protocol service. This characteristic identifies the accessory selected by the user from the UI of the controller **102**.

The user interface can be device specific. In some embodiments, the controller **102** may have programmable buttons for user interface elements. In some embodiments, the controller may have soft keys for user interface elements. The functions for the computing device can vary based on the software release for the computing device. In some embodiments, the functions include allowing a user to access web video applications. The functions can also include the standard functions associated with a digital media player including playing movies and shows, playing music, games, streaming live sports and news, presenting digital content from Apps like Amazon Prime Video, Hulu, ESPN, and Netflix. The functions can also include accessing a virtual assistant. The functions can also include casting audio and video from other computing devices and allowing a user to browse the internet.

In some embodiments, the functions of the computing device can be associated with one or more accessories on a network. For example, the function may include turning on an alarm, locking a door, turning off a lightbulb or adjusting the thermostat.

This same action can be performed by the network daemon on each media access device **118** that has been associated with the controller **102**. When the user selects one of the associated accessories in the user interface of the controller **102**, the controller **102** modifies the Active Identifier networking protocol characteristic to match the identifier of the media access networking device **118** configured as part of the association. The network daemon on each of the associated media devices **118** notice the change and only the media access device **118** that matches the value in the Active Identifier networking protocol characteristic will register to receive notifications from the user interface elements (buttons) from the controller **102**.

At **308**, the technique can include receiving, by the computing device, a third signal from the controller, the third signal indicating interaction with a selected user interface element on the controller. The third wireless signal can be a wired or wireless signal. The interaction with the selected user interface element can include the activation of the user interface element by physical contact with the user interface element. In some embodiments, the interaction with the selected user interface element can include detecting a gesture of a user on the touch screen display of the controller **102**. In some embodiments, the interaction with the selected user interface element can include detecting the acceleration or movement of the controller **102**. The activation of the user interface element can be a tactile input of a user on a touchscreen display or depressing a button on the controller **102**.

When the user interacts with any of the user interface elements or buttons in the user interface of the controller **102**, the controller **102** generates a notification on the user interface element event network protocol characteristic. The network daemon on the media access device **118** matching the Active Identifier networking protocol characteristic receives this user interface element event and translates it to the media access networking device **118** for performing a specific action, In some embodiments, the specific action can include a function for the media access device **118** such as Play, Pause, Rewind, Forward, 2× rewind, 2× forward, Menu, etc.

At **310**, the technique can include performing, by the computing device, the function associated with the selected user interface element. Upon receipt of the third signal, the computing device can perform the function associated with the user interface element on the controller **102**.

It will be appreciated that process **300** is illustrative and that variations and modifications are possible. Steps described as sequential may be executed in parallel, order of steps may be varied, and steps may be modified, combined, added or omitted.

When the user selects a different media access and home networking device in the user interface of the controller **102**, the controller **102** modifies the Active Identifier networking protocol characteristic to match the Identifier of the media access networking device **118** configured as part of the association. The network daemon on the previously selected media access device **118** shuts off the notifications on the user interface element event network protocol characteristic of the controller **102** networking protocol service and network daemon on the newly selected media device **118** will start listening for the new user interface element value networking protocol characteristic.

Another advantage of the present disclosure is the ability of the network to reconfigure the controller **102** to account for configuration changes. In some embodiments, the technique includes identifying, by the computing device, a change in the configuration information for the computing device. The technique can also include transmitting, by the computing device, a fourth signal that includes revised configuration information for associating functions of the computing device with the user interface element value for the controller. The fourth signal may be a wired or wireless signal. For example, if the media access device **118** initially only enables nine user interface elements (buttons). If a software update for the media access device **118** results in enabling **23** user access elements, the technique will identify

this configuration change and transmit the configuration information the controller **102**. The configuration can change so the appropriate controller **102** would also change without the user having to reconfigure the controller **102** through the controller interface. The protocol can be changed not just to control one media access device **118**, but can be used to control other media devices.

Another feature of the present disclosure is to enable the controller to control accessories in the network (e.g., a home network). The network can be configured to control one or more accessories (e.g., lights, alarm, garage doors, blinds, thermostats). Once configured with the network protocol, the controllers **102** can be used to control various accessories previously only controlled by a proprietary or network enabled controller.

The network protocol has a way of remapping the user interface element types on the controller **102**. The protocol can also provide names to the user interface elements. For example, if the controller **102** can support more user interface elements than required by the media access device **118**. In the present technique, the controller **102** does not know what function user interface element commands. Remote control manufactures only support a limited number of languages to display names of user interface elements. Some networks support many more languages, and having the protocol supply the names of the user interface elements will allow a controller **102** to be more robust by displaying user interface elements in many more native languages.

In various embodiments, the information packets from the controller to the media access device are over internet protocol (IP).

In some embodiments, the technique includes authorizing the controller **102** to control one or more accessories of various types that are connected to the computing device. The accessories can be connected to the computing device via a wired or wireless connection.

In some embodiments, the technique includes synchronizing the control of the one or more accessories such that a command from the controller **102** will perform a related function for each of a same type of accessory.

In some embodiments, the technique includes causing an interface of the controller **102** to display representations of the one or more accessories on a display of the controller **102**.

In some embodiments, the technique can include receiving, from the controller **102**, authorization for the computing device to control one or more accessories of various types that are connected to the controller. The technique can include synchronizing the control of the one or more accessories such that a command from the computing device will perform a related function for each of a same type of accessory. The technique can include providing an interface for a user to select the one or more accessories on the computing device.

FIG. **4** illustrates a diagram for a network **400** for a technique for authorizing universal devices according to an embodiment of the present disclosure. FIG. **4**. illustrates three devices used for the disclosed technique. The devices include a controller **402**, a computing device **406**, and an accessory. In some embodiments the network **400** can be a home network.

The controller **402** can be a universal controller can be a proprietary controller device programmed to control one or more devices or accessories. In some embodiments, the controller **402** can be configured to send and receive wireless signals. In some embodiments, the controller **402** can be configured to send or receive wired signals. The controller **402** can have a processor to execute programmed instructions saved in a memory of the controller **402**. The controller can have a display. The display can be a touch screen display. The touch screen display can be programmed to present user interface elements (buttons) or soft-keys. In some embodiments, the user interface elements are capable of being programmed or reprogrammed with instructions. The instructions can be saved in a memory of the device.

The computing device **404** can include a media access device **118**. The computing device **404** can programmed to control one or more devices or accessories. In some embodiments, the computing device **404** can be configured to send and receive wireless signals. In some embodiments, the computing device **404** can be configured to send or receive wired signals. The computing device **404** can have a processor to execute programmed instructions saved in a memory of the computing device **404**. The computing device can have a display. The display can be a touch screen display. The touch screen display can be programmed to present user interface elements (buttons) or soft-keys. In some embodiments, the user interface elements are capable of being programmed or reprogrammed with instructions. The instructions can be saved in a memory of the computing device. The computing device can include a media player or Bluetooth speaker.

The accessory **406** can one or more devices including a door lock, garage door system, window blinds, light fixture, security camera, and thermostat. The accessory **406** can be controlled by the controller **402** or can be controlled by a computing device **404** or through a network interface device.

At **410**, the technique for authorizing universal devices according to an embodiment of the present disclosure can include receiving a network code by the computing device. In some embodiments, the network code can be identified via a user interface of an application for the network. In some embodiments, the network can be a home network. In some embodiments, the computing device can be the media access device **118**, shown in FIG. **1**.

The network code can be a numeric or alpha-numeric code of varying length (e.g., an eight-digit network code.) In various embodiments, the network code can be provided by the accessory or the controller **102** via a label or display on the device, packing materials, or instructions for the device. In some embodiments, a machine-readable code such as a barcode or a Quick Response (QR) code can contain the network code. In some embodiments, the machine-readable code can be printed on the label for the accessory or the controller. In these embodiments, entering the network code can be established by scanning the machine-readable code with a device capable of reading the machine-readable code. In some embodiments, controllers can be smartphones or tablets with digital imaging devices (e.g., a camera) that are capable of reading the machine-readable code.

In some embodiments, the computing device **404**, can be controlled through an application on a smartphone, a tablet, a laptop, or other computing device. Various applications (Apps for short) can be developed to control the interaction between computing device **404**, accessories, and controllers. The application can provide a user interface which allows a user to manually enter the network code. In some embodiments, the network code can be entered through a keyboard or keypad. In some embodiments, the network code can be entered via a virtual keyboard. In some embodiments, the application can enable a user to scan the machine-readable

code with a camera on the device executing the application. Scanning the machine-readable code can capture the network code in the application.

The pair verify process can be performed prior to any networking protocol session. Pair verify verifies the pairing between a computing device, and a controller or an accessory. Pair verify establishes an ephemeral shared secret to secure the networking protocol session.

At **412**, the technique for adding a controller can include, transmitting by the computing device **404**, a first signal to the controller, the first signal configured to register the controller **402** to receive configuration information from the computing device **404**. The first signal can be a wired or wireless signal. The controller **402** can receive the first signal and establish a link between the computing device **404** and the controller **402**.

At **414**, the controller **402** is registered with the network and configured to receive the configuration information from the computing device **404**.

At **416**, the technique includes transmitting, by the computing device, a second signal to the controller, the second signal including the configuration information for the controller, the configuration information associating a function for the computing device with a user interface element value for the controller. The second signal can be a wired or wireless signal. Unlike traditional universal controllers which rely on selecting a variety of infrared (IR) codes for a specific device, the techniques disclosed herein involve transmitting a configuration from the computing device to the controller **402**. In this way, the configuration can change as the features on the controller **402** changes.

After one or more controllers and media access device are added to the network, a network daemon and framework provide interface to manage the association of media access and networking device **118** with the controllers. Different network clients such as a home networking application or television settings application these interfaces to provide a user interface (UI) for user to manage these associations. When a computing device **404** is associated with a controller **402**, the network daemon making this association will configure the controller **402** with the configuration for the user interface elements so that the controller **402** can generate events to any interested controllers. The user interface elements can also be referred to as buttons. The network daemon on the computing device **404** that has been associated with the controller **402** can register for notifications with the networking protocol characteristic in an accessory control network protocol service. This networking protocol characteristic identifies the accessory selected by the user from the user interface of the controller **402**.

At **418**, the controller **402** can be configured with the configuration information for the computing device **404**. In some embodiments, the controller **402** can load the configuration information from the second signal into a memory of the controller **402**. In some embodiments, the configuration can include a series of computer readable instructions that cause the processor in the controller. The configuration information can associate a function on the computing device **402** or accessory **406** to be performed upon interaction with the user interface element.

The user interface can be device specific. In some embodiments, the controller **402** may have programmable buttons for user interface elements. In some embodiments, the controller **402** may have soft keys for user interface elements. The functions for the computing device **404** can vary based on the software release for the computing device **404**. In some embodiments, the functions include allowing a user to access web video applications. The functions can also include the standard functions associated with a digital media player including playing movies and shows, playing music, games, streaming live sports and news, presenting digital content from Apps like Amazon Prime Video, Hulu, ESPN, and Netflix. The functions can also include accessing a virtual assistant. The functions can also include casting audio and video from other computing devices and allowing a user to browse the internet.

In some embodiments, the functions of the computing device **404** can be associated with one or more accessories on a network. For example, the function may include turning on an alarm, locking a door, turning off a lightbulb or adjusting the thermostat.

This same action can be performed by the network daemon on each computing device **404** that has been associated with the controller **402**. When the user selects one of the associated accessories in the user interface of the controller **402**, the controller **402** modifies the networking protocol characteristic to match the identifier of the computing device **404** configured as part of the association. The network daemon on each of the associated computing device **404** notice the change and only the computing device **404** that matches the value in the networking protocol characteristic will register to receive notifications from the user interface elements (buttons) from the controller **402**.

At **420**, the controller **402** can receive an interaction with a selected user interface element on the controller **402**. The interaction with the selected user interface element can include the activation of the user interface element by physical contact with the user interface element. In some embodiments, the interaction with the selected user interface element can include detecting a gesture of a user on the touch screen display of the controller **402**. In some embodiments, the interaction with the selected user interface element can include detecting the acceleration or movement of the controller **402**. The activation of the user interface element can be a tactile input of a user on a touchscreen display or depressing a button on the controller **402**. The interaction with the user interface element can generate a third signal to be transmitted to the computing device **404**. The third signal can be wired or wireless. The third signal can include information sufficient to indicate the function desired by the computing device **404** or the accessory **406**.

At **422**, the technique can include receiving, by the computing device **404**, the third signal from the controller, the third signal indicating interaction with a selected user interface element on the controller. The computing device **404** can process the third signal and execute selected functions designed to be performed by the computing device **404**. The computing device **404** can also receive the third signal and generate a command signal to an accessory. The command signal can be wired or wireless.

When the user interacts with any of the user interface elements or buttons in the user interface of the controller **402**, the controller **402** generates a notification on the user interface element event network protocol characteristic. The network daemon on the computing device **404** matching the networking protocol characteristic receives this user interface element event and translates it to the computing device **404** for performing a specific action, In some embodiments, the specific action can include a function for the computing device **404** such as Play, Pause, Rewind, Forward, 2× rewind, 2× forward, Menu, etc.

At **424**, the technique can include performing, by the computing device **404**, the function associated with the selected user interface element. Upon receipt of the third

signal, the computing device can perform the function associated with the user interface element on the controller **402**. In some embodiments, the upon receiving the third signal, the computer interface can instruct an accessory **406** or device to perform a specific function.

At **426**, the accessory **406** can receive the command signal and perform the function provided by the command signal. In some embodiments, the function can be activating the device. In some embodiments, the function can be deactivating the device.

It will be appreciated that process **400** is illustrative and that variations and modifications are possible. Steps described as sequential may be executed in parallel, order of steps may be varied, and steps may be modified, combined, added or omitted.

IV. Virtual Assistant

In various embodiments, a virtual assistant can be used to interact with a media access device **118** such as a television set-top box controlling content shown on a television display. A mobile user device **118** or a controller **102** with a microphone can be used to receive speech input for the virtual assistant. The user's intent can be determined from the speech input, and the virtual assistant can execute tasks according to the user's intent, including causing playback of media on a connected television and controlling any other functions of a television set-top box or like device (e.g., managing video recordings, searching for media content, navigating menus, etc.).

Virtual assistant interactions can be shown on a connected television or other display. In one example, media content can be determined based on speech input received from a user. A first user interface with a first small size can be displayed, including selectable links to the determined media content. In some embodiments, after receiving a selection of a media link, a second user interface with a second larger size can be displayed, including the media content associated with the selection. In other examples, the interface used to convey virtual assistant interactions can expand or contract to occupy a minimal amount of space while conveying desired information.

In some examples, multiple devices associated with multiple displays can be used to determine user intent from speech input as well as to convey information to users in different ways. For example, speech input can be received from a user at a first device having a first display. The user's intent can be determined from the speech input based on content displayed on the first display. Media content can be determined based on the user intent, and the media content can be played on a second device associated with a second display.

Media display content can also be used as contextual input for determining user intent from speech input. For example, speech input can be received from a user, including a query associated with content shown on a television display. The user intent of the query can be determined based on the content shown on the television display as well as a viewing history of media content on the television display (e.g., disambiguating the query based on characters in a playing multimedia show). The results of the query can then be displayed based on the determined user intent.

In some examples, virtual assistant query suggestions can be provided to the user (e.g., to acquaint the user with available commands, suggest interesting content, etc.). For example, media content can be shown on a display, and an input can be received from the user requesting virtual assistant query suggestions. Virtual assistant queries suggestions can be determined based on the media content shown on the display and a viewing history of media content shown on the display (e.g., suggesting queries related to a playing multimedia show). The suggested virtual assistant queries can then be shown on the display.

Controlling television user interactions using a virtual assistant according to the various examples discussed herein can provide an efficient and enjoyable user experience. User interactions with media control devices can be intuitive and simple using a virtual assistant capable of receiving natural language queries or commands. Available functions can be suggested to users as desired, including meaningful query suggestions based on playing content, which can aid users to learn control capabilities. In addition, available media can be made easily accessible using intuitive spoken commands. It should be understood, however, that still many other advantages can be achieved according to the various examples discussed herein.

The term "television" can thus refer to any type of display associated with any of a variety of devices. Moreover, the terms "virtual assistant," "digital assistant," "intelligent automated assistant," or "automatic digital assistant" can refer to any information processing system that can interpret natural language input in spoken and/or textual form to infer user intent, and perform actions based on the inferred user intent. For example, to act on an inferred user intent, the system can perform one or more of the following: identifying a task flow with steps and parameters designed to accomplish the inferred user intent; inputting specific requirements from the inferred user intent into the task flow; executing the task flow by invoking programs, methods, services, APIs, or the like; and generating output responses to the user in an audible (e.g., spoken) and/or visual form.

A virtual assistant can be capable of accepting a user request at least partially in the form of a natural language command, request, statement, narrative, and/or inquiry. Typically, the user request seeks either an informational answer or performance of a task by the virtual assistant (e.g., causing display of particular media). A satisfactory response to the user request can include provision of the requested informational answer, performance of the requested task, or a combination of the two. In response, the virtual assistant can acknowledge the request and then create an appropriate reminder item in the user's electronic schedule. During the performance of a requested task, the virtual assistant can sometimes interact with the user in a continuous dialogue involving multiple exchanges of information over an extended period of time. There are numerous other ways of interacting with a virtual assistant to request information or performance of various tasks. In addition to providing verbal responses and taking programmed actions, the virtual assistant can also provide responses in other visual or audio forms (e.g., as text, alerts, music, videos, animations, etc.). Moreover, as discussed herein, an exemplary virtual assistant can control playback of media content (e.g., playing video on a television) and cause information to be displayed on a display.

An example of a virtual assistant is described in Applicants' U.S. Utility application Ser. No. 12/987,982 for "Intelligent Automated Assistant," filed Jan. 10, 2011, the entire disclosure of which is incorporated herein by reference and for all purposes.

Further description on the functionality of virtual assistants for TV user interactions is described in U.S. Utility application Ser. No. 15/085,465 for "Intelligent Automated Assistant for TV User Interactions," filed Mar. 30, 2016, now U.S. Pat. No. 9,668,024, the entire disclosure of which is incorporated herein by reference and for all purposes.

The present disclosure relates to the access to a virtual assistant by universal controllers. The controller **102** can include a microphone for capturing audio input (e.g., speech input from a user), a button(s) for capturing tactile input, and transceiver for facilitating communication with the media access device **118** via a controller **102**. The controller **102** can also include other input mechanisms, such as a keyboard, joystick, touchpad, or the like. The controller **102** can further include output mechanisms, such as lights, a display, a speaker, or the like. Input received at the controller **102** (e.g., user speech, button presses, etc.) can be communicated to the media access and home networking device via controller. I/O subsystem can also include other input controller(s).

In order to transport the audio information from a universal controller to a media access device **118** a proper channel a channel can be configured. The framework for the protocol for opening a channel is described commonly-owned U.S. Patent Application Ser. No. 62/575,373, filed Oct. 21, 2017, entitled "Personal Domain for a Virtual Assistant System on a Communal Device," the entire disclosure of which is incorporated herein by reference and for all purposes.

FIG. **5** illustrates a simplified flow diagram for a technique for opening a channel according to an embodiment of the present disclosure. In order to establish a channel for the transfer of audio data a socket can be first be created. In the technique for opening a channel as described in FIG. **5**, several components are described. An accessory network **502** can include a wireless network in which one or more controllers can be used to control one or more accessories. The accessory network **502** can include a home network. The accessory network normally employs a protocol for control of accessories. Some protocols support both IP and Bluetooth LE. The protocol can be protocol mapped over HTTP/S with discovery leveraging Bonjour. The protocol messages between the OS and the network compliant devices use JavaScript Object Notation (JSON) (and hence JSON parsing would be required). JavaScript Object Notation or JSON is an open-standard file format that uses human-readable text to transmit data objects consisting of attribute-value pairs and array data types.

A socket is one endpoint of a two-way communication link between two programs running on the network. A socket is bound to a port number so that the TCP layer can identify the application that data is destined to be sent to. An accessory socket is an accessory channel endpoint **504** associated with an accessory that is connected to the network. A controller socket is an controller channel endpoint **506** associated with a controller that is connected to the network.

In multitasking computer operating systems, a demon is a computer program that runs as a background process, rather than being under the direct control of an interactive user. A demon is a program or process, part of a larger program or process, that is dormant until a certain condition occurs and then is initiated to do its processing. A controller demon **508** is a computer program associated with a controller that is dormant under certain conditions occurs and then runs as a background process.

At **510**, the controller **508** provides instructions to set-up a bulk channel. These instructions can be wirelessly communicated to the computing device. In some embodiments, the instructions to set-up the bulk channel can be communicated through a wired connection.

At **512**, the home network receives the instructions from the controller demon to set-up the bulk channel. The computing device receives the instructions and takes the steps necessary to set-up and configure the bulk channel.

At **514**, the computing device provides instructions to create a channel. One type of a bi-directional channel can be a listener or server socket. Listener or server sockets open a port on the network and then wait for a client to connect to that port. Although other network address families and protocols exist, one example is for creating remote service for a TCP/IP network. The unique address of a TCP/IP service can be defined by combining the IP address of the host with the port number of the service to create an endpoint for the service. The DNS class provides methods that return information about the network addresses supported by the local network device. When the local network device has more than one network address, or if the local system supports more than one network device, the DNS class returns information about all network addresses, and the application can choose the proper address for the service.

At **518**, the computing device transmits configuration information to the controller. The configuration information can include the identifier, status, address, and port information. Sockets are assumed to be associated with a specific socket address, namely the IP address and a port number for the local node, and there is a corresponding socket address at the foreign node (other node), which itself has an associated socket, used by the foreign process. Associating a socket with a socket address is called binding. In computer networking, a port is an application-specific or process-specific software construct serving as a communications endpoint used by Transport Layer protocols of the Internet Protocol Suite, such as TCP and UDP. Ports can be identified by their port number (between 0 and 65535).

At **520**, the controller demon receives the configuration information. The configuration information can be saved on the computing device.

At **522**, the controller demon instructs the controller to connect to the controller channel endpoint **506**. The controller demon uses the configuration information to connect to the channel.

At **524**, the controller socket using the configuration information provided in step **520**, initiates connection to the controller channel endpoint **506**. Once the channel endpoint is connected a communications channel is formed allowing for transfer of data between the home network and the controller. After the channel is formed, the procedures for transfer of audio information of a virtual assistant can be performed in process **500** as shown in FIG. **6**.

At **526**, after a pre-determined time period the idle timeout is reached. After this time period, the controller demon will send instructions to the controller channel endpoint to close the channel. The idle time can be varied as necessary.

At **528**, the controller channel endpoint closes the channel.

At **530**, the controller channel endpoint acknowledges the teardown of the channel and transmits the teardown message to the controller demon.

At **532**, the controller demon receives the acknowledgement of the teardown thereby ending the process.

It will be appreciated that process **500** is illustrative and that variations and modifications are possible. Steps described as sequential may be executed in parallel, order of steps may be varied, and steps may be modified, combined, added or omitted.

FIG. **6** illustrates a simplified flow diagram for a technique virtual assistant control **600** from a universal controller according to an embodiment of the present disclosure. The technique for enabling a universal controller activate a

virtual assistant for a network can include several components including a controller user interface **602**, network protocol **604**, a media access device (MAD) demon **606**, and a MAD assistant interface **608**. The controller user interface **602** can include a plurality of user interface elements (buttons) that allow a user to activate the virtual assistant. The network protocol **604** can enable the controller to communicate with accessories. In some embodiments, the network protocol is for a home network. However, the network protocol **604** describe in FIG. **6** is not limited to the HAP. The media access device demon **606** can communicate commands to the controller. The media access device assistant interface **608** allows the virtual assistant to communicate with the media access device and the network.

At **610**, the process starts when a user activates a virtual assistant on the controller user interface. Activation of the virtual assistant can include touching a user interface element associated with the virtual assistant or depressing a physical button on the controller that is associated with the virtual assistant.

At **612**, the home network protocol creates a virtual assistant session. If the accessory and controller sockets are not created, as described in FIG. **5**, the channel creation technique is activated.

At **614**, the media access device demon executes a pre-warm application. During the pre-warm application, one or more applications can be pre-loaded or activated in anticipation of receipt of information via a channel. In some embodiments, the information is audio information. The pre-load process can reduce any latency with transcribing or executing the instructions captured in the audio information.

At **616**, the media access device indicates that the virtual assistant is active for listening. For example, a media access device can present some visual indication on a display that the virtual assistant is capturing the audio information. In some embodiments, the visual indication may be a appear as animation that will change as audio is captured. In some embodiments, the media access device will emit an auditory tone such as one or more tones or beeps. In some embodiments, the media access device will illuminate one or more light emitting diodes (LEDs) indicating the media access device is capturing the information.

At **618**, the controller records audio from a microphone on the controller. In some embodiments, the audio can be saved on the controller as a packet of digital information. The controller can capture the audio information from the microphone starting from the moment when the virtual assistant is activated. The audio stream can be broken up into audio packets. In some embodiments, the size of the audio packets can be varied. In some embodiments, the audio packets capture 20 milliseconds of audio information. In some embodiments, the audio packets can be 2.5 milliseconds of audio information. In some embodiments, the controller can capture digital information other than audio information to send to the media access device.

At **620**, the controller transmits the audio packet to the media access device via a signal. In some embodiments, the signal can be a wired or wireless signal. The audio information can be sent from a controller channel endpoint through a b-directional channel to the media access device channel endpoint. The media access device demon receives the audio packet.

At **622**, the media access device demon converts the audio packet to a partial transcript. The partial transcript can be a single or a plurality of letters. The partial transcript can be a few words to a phrase. The media access device demon sends the audio packet to the virtual assistant interface. In some embodiments, the virtual assistant processing can be performed using a cloud storage device. The virtual assistant processing can understand the audio information and convert it to text. The text will be sent back the media access device assistant interface. The media access device can communicate with the display interface for displaying the text. The controller can transmit the audio information as fast as the packets are generated. In some embodiments, the packets can be sent every 20 milliseconds of audio information. In some embodiments, the audio packets can be sent every 2.5 milliseconds.

At **624**, the media access device assistant interface outputs a partial transcript. In some embodiments, the partial transcript can be displayed in a portion of the display connected to the media access device.

At **626**, the controller user interface determines if the audio capture is completed. If the audio capture is not completed the process continues to record audio from a microphone.

At **628**, if the audio capture is completed, the controller transmits the remaining audio packet(s) to the media access device demon.

At **630**, the media access device demon converts the remaining audio packet(s) to a partial transcript. The media access device demon sends the audio packet to the virtual assistant interface. In some embodiments, the virtual assistant processing can be performed using a cloud storage device. The virtual assistant processing can understand the audio information and convert it to text. The text will be sent back the media access device assistant interface. The media access device can communicate with the display interface for displaying the text. The controller can transmit the audio information as fast as the packets are generated. In some embodiments, the packets can be sent every 20 milliseconds of audio information. In some embodiments, the audio packets can be sent every 2.5 milliseconds.

At **632**, the media access device assistant interface outputs the remaining transcript. In some embodiments, the partial transcript can be displayed in a portion of the display connected to the media access device.

At **634**, the controller user interface deactivates the virtual assistant. In some embodiments, the deactivation can occur by releasing a button. In some embodiments, the deactivation can occur by selecting a user interface element on the controller. In some embodiments, the controller can detect the end of audio information and automatically deactivate the virtual assistant.

At **636**, the controller outputs the result or reply to the request. In some embodiments, the results can be displayed in a portion of the display connected to the media access device. In some embodiments, the results may be displayed in list or tabular form on the display. In some embodiments, the results can be to execute a certain function on the media access device. In some embodiments, the results can be to play a multimedia asset on the media access device. In some embodiments, the results can be to execute a function for an accessory in communication with the media access device.

It will be appreciated that process **600** is illustrative and that variations and modifications are possible. Steps described as sequential may be executed in parallel, order of steps may be varied, and steps may be modified, combined, added or omitted.

FIG. **7** illustrates a simplified flow diagram for a technique of enabling a controller device access a virtual assistant according to another embodiment of the present disclosure.

At **702**, the technique includes receiving, by the computing device, an information packet via the third signal. In some embodiments, the information packet can include recorded audio information from the controller.

At **704**, the technique includes translating, by the computing device, the information packet into a partial transcript of text, wherein the partial transcript of text includes one or more characters of text.

At **706**, the technique includes preparing for output, at the computing device, the partial transcript of text. In some embodiments, the output can include displays on a display screen.

At **708**, the technique includes performing, by the computing device, one or more functions based at least in part on execution of one or more instructions associated with the partial transcript of text.

It will be appreciated that process **700** is illustrative and that variations and modifications are possible. Steps described as sequential may be executed in parallel, order of steps may be varied, and steps may be modified, combined, added or omitted.

FIG. **8** illustrates a simplified flow diagram for instructions **800** in a computer readable medium for accessory control according to an embodiment of the present disclosure. The techniques include a computer-readable medium storing a plurality of instructions that, when executed by one or more processors of a host computing device, cause the one or more processors to perform operations.

At **802**, the operations include receiving, by the computing device for a network, a network code for adding a controller. In some embodiments, the network code identified via a user interface of an application for the network.

At **804**, the operations include transmitting, by the computing device, a first signal to the controller, the first signal configured to register the controller to receive configuration information from the computing device.

At **806**, the operations include transmitting, by the computing device, a second signal to the controller, the second signal including the configuration information for the controller, the configuration information associating a function for the computing device with a user interface element value for the controller.

It will be appreciated that process including computer readable instructions **700** is illustrative and that variations and modifications are possible. Steps described as sequential may be executed in parallel, order of steps may be varied, and steps may be modified, combined, added or omitted.

V. Example Device Architectures

FIG. **9** shows a simplified block diagram of a computer system **900** according to an embodiment of the present disclosure. In some embodiments, computer system **900** can implement any or all of the functions, behaviors, and capabilities described herein as being performed by a server, as well as other functions, behaviors, and capabilities not expressly described. In some embodiments, other physical instances of computer system **900** can implement any or all of the functions, behaviors, and capabilities described herein as being performed by a controller or an accessory; further examples of controller and accessory implementations are described below. In some embodiments, the computer system can be a media access device.

Computer system **900** can include processing subsystem **902**, storage subsystem **904**, user interface **906**, and network interface **908**. Computer system **900** can also include other components (not explicitly shown) such as a power controllers, and other components operable to provide various enhanced capabilities. Computer system **900** can also be implemented in a large-scale architecture such as a scalable server system or server farm that can include many interconnected processors, storage systems and interfaces, capable of processing and responding to high volumes of requests from client devices including controllers and/or accessories.

Storage subsystem **904** can be implemented, e.g., using disk, flash memory, or any other non-transitory storage medium, or a combination of media, and can include volatile and/or non-volatile storage media. In some embodiments, storage subsystem **904** can store one or more application and/or operating system programs to be executed by processing subsystem **902**, including programs to implement any or all operations described herein as being performed by any of the servers of relay service **220**, as shown in FIG. **2**, as well as data associated with such operations In instances where computer system **900** implements a server, storage subsystem **904** can be implemented using network storage technologies and/or other technologies that can manage high-volume data access requests.

User interface **906** can include input devices such as a touch pad, touch screen, scroll wheel, click wheel, dial, button, switch, keypad, microphone, or the like, as well as output devices such as a video screen, indicator lights, speakers, headphone jacks, or the like, together with supporting electronics (e.g., digital-to-analog or analog-to-digital converters, signal processors, or the like). In some embodiments, a user can operate input devices of user interface **906** to invoke the functionality of computer system **900** and can view and/or hear output from computer system **900** via output devices of user interface **906**. In instances where computer system **900** implements a server, user interface **906** can be remotely located with respect to processing subsystem **902** and/or storage subsystem **904**.

Processing subsystem **902** can be implemented using one or more integrated circuits, e.g., one or more single-core or multi-core microprocessors or microcontrollers, examples of which are known in the art. In operation, processing subsystem **902** can control the operation of computer system **900**. In various embodiments, processing subsystem **902** can execute a variety of programs in response to program code and can maintain multiple concurrently executing programs or processes. At any given time, some or all of the program code to be executed can be resident in processing subsystem **902** and/or in storage media such as storage subsystem **904**.

Through suitable programming, processing subsystem **902** can provide various functionality for computer system **900**. For example, where computer system **900** implements a server of relay service **220**, as shown in FIG. **2**, processing subsystem **902** can implement various processes (or portions thereof) described above as being implemented by any or all of certificate server, identity server, accessory courier server, controller courier serve, message passing server(s), pass server, and/or reporting server. Processing subsystem **902** can also execute other programs to control other functions of computer system **900**, including programs that may be stored in storage subsystem **904**.

Network communication interface **908** can provide voice and/or data communication capability for computer system **900**. In some embodiments, network communication interface **908** can include radio frequency (RF) transceiver components for accessing wireless data networks (e.g., using data network technology such as 3G, 4G/LTE, IEEE 802.11 family standards (e.g., Wi-Fi network technology), or other mobile communication technologies, or any combination thereof), components for short-range wireless communication (e.g., using Bluetooth and/or Bluetooth LE stan-

dards, NFC, etc.), and/or other components. In some embodiments, network communication interface **908** can provide wired network connectivity (e.g., Ethernet) in addition to or instead of a wireless interface. Network communication interface **908** can be implemented using a combination of hardware (e.g., driver circuits, antennas, modulators/demodulators, encoders/decoders, and other analog and/or digital signal processing circuits) and software components. In some embodiments, network communication interface **908** can support multiple communication channels concurrently, using the same transport or different transports.

It will be appreciated that computer system **900** is illustrative and that variations and modifications are possible. Computer systems including servers, controller devices, and/or accessories can have functionality not described herein (e.g., a controller device may also provide voice communication via cellular telephone networks; ability to interact with the user to provide personal information, play games, access content via the wireless network and/or locally stored content; etc.), and implementations of these devices and servers can include components appropriate to such functionality.

Further, while a computer system is described herein with reference to particular blocks, it is to be understood that these blocks are defined for convenience of description and are not intended to imply a particular physical arrangement of component parts. Further, the blocks need not correspond to physically distinct components. Blocks can be configured to perform various operations, e.g., by programming a processor or providing appropriate control circuitry, and various blocks might or might not be reconfigurable depending on how the initial configuration is obtained. Embodiments of the present disclosure can be realized in a variety of apparatus including electronic devices implemented using any combination of circuitry and software.

FIG. **10** shows a simplified block diagram of a media access device **1000** according to an embodiment of the present disclosure. Media access device **1000** can implement any or all of the media access device functions, behaviors, and capabilities described herein, as well as other functions, behaviors, and capabilities not expressly described. Media access device **1000** can include processing subsystem **1010**, storage device **1012**, user interface **1014**, communication interface **1016**, secure storage module **1018**, and cryptographic logic module **1020**. Media access device **1000** can also include other components (not explicitly shown) such as a power controllers, and other components operable to provide various enhanced capabilities.

Storage device **1012** can be implemented, e.g., using disk, flash memory, or any other non-transitory storage medium, or a combination of media, and can include volatile and/or non-volatile media. In some embodiments, storage device **1012** can store one or more application and/or operating system programs to be executed by processing subsystem **1010**, including programs to implement various operations described above as being performed by a media access device. Storage device **1012** can also store program code executable to communicate with a relay service **220**, as shown in FIG. **2**, e.g., as described above. In some embodiments, portions (or all) of the media access device functionality described herein can be implemented in operating system programs rather than applications. In some embodiments, storage device **1012** can also store apps designed for specific accessories or specific categories of accessories (e.g., an IP camera app to manage an IP camera accessory or a security app to interact with door lock accessories). In some embodiments, the storage device **1012** can store digital multimedia content.

User interface **1014** can include input devices such as a touch pad, touch screen, scroll wheel, click wheel, dial, button, switch, keypad, keyboard microphone, or the like, as well as output devices such as a video screen, indicator lights, speakers, headphone jacks, or the like, together with supporting electronics (e.g., digital-to-analog or analog-to-digital converters, signal processors, or the like). A user can operate input devices of user interface **1014** to invoke the functionality of media access device **1000** and can view and/or hear output from media access device **1000** via output devices of user interface **1014**. In some embodiments, a user interface **1014** can be a proprietary remote control. In some embodiments, a user interface **1014**, can be implemented as an App for a smartphone, tablet, wearable or other mobile electronic device.

Processing subsystem **1010** can be implemented as one or more integrated circuits, e.g., one or more single-core or multi-core microprocessors or microcontrollers, examples of which are known in the art. In operation, processing system **1010** can control the operation of media access device **1000**. In various embodiments, processing subsystem **1010** can execute a variety of programs in response to program code and can maintain multiple concurrently executing programs or processes. At any given time, some or all of the program code to be executed can be resident in processing subsystem **1010** and/or in storage media such as storage device **1012**.

Through suitable programming, processing subsystem **1010** can provide various functionality for media access device **1000**. For example, in some embodiments, processing subsystem **1010** can implement various processes (or portions thereof) described above as being implemented by a media access device. Processing subsystem **1010** can also execute other programs to control other functions of media access device **1000**, including application programs that may be stored in storage device **1012**. In some embodiments, these application programs may interact with an accessory, e.g., by generating messages to be sent to the accessory and/or receiving responses from the accessory. Such interactions can be facilitated by an accessory management daemon and/or other operating system processes, e.g., as described above, and can include communicating with the accessory via a relay service **220**, as shown in FIG. **2**, as described above.

Communication interface **1016** can provide voice and/or data communication capability for media access device **1000**. In some embodiments communication interface **1016** can include radio frequency (RF) transceiver components for accessing wireless voice and/or data networks (e.g., using cellular telephone technology, data network technology such as 3G, 4G/LTE, Wi-Fi, other IEEE 802.11 family standards, or other mobile communication technologies, or any combination thereof), components for short-range wireless communication (e.g., using Bluetooth and/or Bluetooth LE standards, NFC, etc.), and/or other components. In some embodiments communication interface **1016** can provide wired network connectivity (e.g., Ethernet) in addition to or instead of a wireless interface. Communication interface **1016** can be implemented using a combination of hardware (e.g., driver circuits, antennas, modulators/demodulators, encoders/decoders, and other analog and/or digital signal processing circuits) and software components. In some embodiments, communication interface **1016** can support multiple communication channels concurrently or at differ-

ent times, using the same transport or different transports. Thus, for example, media access device **1000** can communicate with accessories via a local channel at some times and via a relay service **220**, as shown in FIG. **2**, at other times.

Secure storage module **1018** can be an integrated circuit or the like that can securely store cryptographic information for media access device **1000**. Examples of information that can be stored within secure storage module **1018** include the media access device's long-term public and secret keys **1022** (LTPKC, LTSKC), a list of local pairings **1024** (e.g., a lookup table that maps a local accessory identifier to an accessory long-term public key (LTPKA) for accessories that have completed a local pair setup or pair add process, e.g., as described above, with media access device **1000**), and a list of relay pairings **1026** (e.g., accessory RAs and associated access tokens for accessories that have established a relay pairing, e.g., as described above, with media access device **1000**). In some embodiments, pairing information can be stored such that a local pairing **1024** is mapped to the corresponding relay pairing **1026** in instances where both a local pairing and a relay pairing with the accessory have been established.

In some embodiments, cryptographic operations can be implemented in a cryptographic logic module **1020** that communicates with secure storage module **1018**. Physically, cryptographic logic module **1020** can be implemented in the same integrated circuit with secure storage module **1018** or a different integrated circuit (e.g., a processor in processing subsystem **1010**) as desired. Cryptographic logic module **1020** can include various logic circuits (fixed or programmable as desired) that implement or support cryptographic operations of media access device **1000**, including any or all cryptographic operations described above. Secure storage module **1018** and/or cryptographic logic module **1020** can appear as a "black box" to the rest of media access device **1000**. Thus, for instance, communication interface **1016** can receive a message in encrypted form that it cannot decrypt and can simply deliver the message to processing subsystem **1010**. Processing subsystem **1010** may also be unable to decrypt the message, but it can recognize the message as encrypted and deliver it to cryptographic logic module **1020**. Cryptographic logic module **1020** can decrypt the message (e.g., using information extracted from secure storage module **1018**) and determine what information to return to processing subsystem **1010**. As a result, certain information can be available only within secure storage module **1018** and cryptographic logic module **1020**. If secure storage module **1018** and cryptographic logic module **1020** are implemented on a single integrated circuit that executes code only from an internal secure repository, this can make extraction of the information extremely difficult, which can provide a high degree of security. Other implementations are also possible.

FIG. **11** shows a simplified block diagram of an accessory **1100** according to an embodiment of the present disclosure. Accessory **1100** can implement any or all of the accessory functions, behaviors, and capabilities described herein, as well as other functions, behaviors, and capabilities not expressly described. Accessory **1100** can include storage device **1128**, processing subsystem **1130**, user interface **1132**, accessory-specific hardware **1134**, communication interface **1136**, secure storage module **1138**, and cryptographic logic module **1140**. Accessory **1100** can also include other components (not explicitly shown) such as a battery, power media access devices, and other components operable to provide various enhanced capabilities.

Accessory **1100** is representative of a broad class of accessories that can be operated by a media access device such as controller, and such accessories can vary widely in capability, complexity, and form factor. Various accessories may include components not explicitly shown in FIG. **11**, including but not limited to storage devices (disk, flash memory, etc.) with fixed or removable storage media; video screens, speakers, or ports for connecting to external audio/video devices; camera components such as lenses, image sensors, and controls for same (e.g., aperture, zoom, exposure time, frame rate, etc.); microphones for recording audio (either alone or in connection with video recording); and so on.

Storage device **1128** can be implemented, e.g., using disk, flash memory, or any other non-transitory storage medium, or a combination of media, and can include volatile and/or non-volatile media. In some embodiments, storage device **1128** can store one or more programs (e.g., firmware) to be executed by processing subsystem **1130**, including programs to implement various operations described above as being performed by an accessory, as well as operations related to particular accessory behaviors. Storage device **1128** can also store an accessory object or accessory definition record that can be furnished to controller devices, e.g., during device discovery as described in above-referenced U.S. application Ser. No. 14/614,914. Storage device **1128** can also store accessory state information and any other data that may be used during operation of accessory **1100**. Storage device **1128** can also store program code executable to communicate with a relay service **220**, as shown in FIG. **2**, e.g., as described above.

Processing subsystem **1130** can include, e.g., one or more single-core or multi-core microprocessors and/or microcontrollers executing program code to perform various functions associated with accessory **1100**. For example, processing subsystem **1130** can implement various processes (or portions thereof) described above as being implemented by an accessory, e.g., by executing program code stored in storage device **1128**. Processing subsystem **1130** can also execute other programs to control other functions of accessory **1100**. In some instances programs executed by processing subsystem **1130** can interact with a controller (e.g., controller), e.g., by generating messages to be sent to the controller and/or receiving messages from the controller. In some instances, the messages can be sent and/or received using a relay service **220**, as shown in FIG. **2**, as described above.

User interface **1132** may include user-operable input devices such as a touch pad, touch screen, scroll wheel, click wheel, dial, button, switch, keypad, microphone, or the like, as well as output devices such as a video screen, indicator lights, speakers, headphone jacks, or the like, together with supporting electronics (e.g., digital-to-analog or analog-to-digital converters, signal processors, or the like). Depending on the implementation of a particular accessory **1100**, a user can operate input devices of user interface **1132** to invoke functionality of accessory **1100** and can view and/or hear output from accessory **1100** via output devices of user interface **1132**. Some accessories may provide a minimal or no user interface. Where the accessory does not have a user interface, a user can still interact with the accessory using a controller (e.g., controller **1200**).

Accessory-specific hardware **1134** can include any other components that may be present in accessory **1100** to enable its functionality. For example, in various embodiments accessory-specific hardware **1134** can include one or more storage devices using fixed or removable storage media; GPS receiver; power supply and/or power management circuitry; a camera; a microphone; one or more actuators;

control switches; environmental sensors (e.g., temperature sensor, pressure sensor, accelerometer, chemical sensor, etc.); and so on. It is to be understood that any type of accessory functionality can be supported by providing appropriate accessory-specific hardware **1134** and that accessory-specific hardware can include mechanical as well as electrical or electronic components.

Communication interface **1136** can provide voice and/or data communication capability for accessory **1100**. In some embodiments communication interface **1136** can include radio frequency (RF) transceiver components for accessing wireless voice and/or data networks (e.g., using cellular telephone technology, data network technology such as 3G, 4G/LTE, Wi-Fi, other IEEE 802.11 family standards, or other mobile communication technologies, or any combination thereof), components for short-range wireless communication (e.g., using Bluetooth and/or Bluetooth LE standards, NFC, etc.), and/or other components. In some embodiments communication interface **1136** can provide wired network connectivity (e.g., Ethernet) in addition to or instead of a wireless interface. Communication interface **1136** can be implemented using a combination of hardware (e.g., driver circuits, antennas, modulators/demodulators, encoders/decoders, and other analog and/or digital signal processing circuits) and software components. In some embodiments, communication interface **1136** can support multiple communication channels concurrently or at different times, using the same transport or different transports. Thus, for example, accessory **1100** can communicate with a controller via a local channel at some times and via a relay service **220**, as shown in FIG. **2**, at other times.

Secure storage module **1138** can be an integrated circuit or the like that can securely store cryptographic information for accessory **1100**. Examples of information that can be stored within secure storage module **1138** include the accessory's long-term public and secret keys **1142** (LTPKA, LTSKA), a list of local pairings **1144** (e.g., a lookup table that maps a local controller identifier to a controller long-term public key (LTPKC) for controllers that have completed a local pair setup or pair add process, e.g., as described above, with accessory **1100**), and a list of relay pairings **1146** (e.g., controller RAs and associated access tokens for controllers that have established a relay pairing, e.g., as described above, with accessory **1100**). In some embodiments, pairing information can be stored such that a local pairing **1144** is mapped to the corresponding relay pairing **1146** in instances where both a local pairing and a relay pairing with the controller have been established. In some embodiments, secure storage module **4038** can be omitted; keys and lists of paired controllers can be stored in storage device **1128**.

In some embodiments, cryptographic operations can be implemented in a cryptographic logic module **1140** that communicates with secure storage module **1138**. Physically, cryptographic logic module **1140** can be implemented in the same integrated circuit with secure storage module **1138** or a different integrated circuit (e.g., a processor in processing subsystem **1130**) as desired. Cryptographic logic module **1140** can include various logic circuits (fixed or programmable as desired) that implement or support cryptographic operations of accessory **1100**, including any or all cryptographic operations described above. Secure storage module **1138** and/or cryptographic logic module **1140** can appear as a "black box" to the rest of accessory **1100**. Thus, for instance, communication interface **1136** can receive a message in encrypted form that it cannot decrypt and can simply deliver the message to processing subsystem **1130**. Processing subsystem **1130** may also be unable to decrypt the message, but it can recognize the message as encrypted and deliver it to cryptographic logic module **1140**. Cryptographic logic module **1140** can decrypt the message (e.g., using information extracted from secure storage module **1138**) and determine what information to return to processing subsystem **1130**. As a result, certain information can be available only within secure storage module **1138** and cryptographic logic module **1140**. If secure storage module **1138** and cryptographic logic module **1140** are implemented on a single integrated circuit that executes code only from an internal secure repository, this can make extraction of the information extremely difficult, which can provide a high degree of security. Other implementations are also possible.

Accessory **1100** can be any electronic apparatus that interacts with controller **1200**. In some embodiments, controller **1200** can provide remote control over operations of accessory **1100** as described below. For example controller **1200** can provide a remote user interface for accessory **1100** that can include both input and output controls (e.g., a display screen to display current status information obtained from accessory **1100** and an input control such as a touch-screen overlay to allow changes to the status information). Controller **1200** in various embodiments can control any function of accessory **1100** and can also receive data from accessory **1100**, via a local channel or a relay service **220**, as shown in FIG. **2**.

FIG. **12** shows a simplified block diagram of a controller **1200** according to an embodiment of the present disclosure. In some embodiments, controller **1200** can implement any or all of the functions, behaviors, and capabilities described herein as being performed by a controller, as well as other functions, behaviors, and capabilities not expressly described. Controller **1200** can include processing subsystem **1210**, storage device **1212**, user interface **1214**, microphone **1216**, secure storage module **1218**, and cryptographic logic module **1220**. Controller **1200** can also include other components (not explicitly shown) such as a battery, power controllers, and other components operable to provide various enhanced capabilities. In various embodiments, controller **1200** can be implemented in a desktop computer, laptop computer, tablet computer, smart phone, other mobile phone, wearable computing device, or other systems having any desired form factor. Further, as noted above, controller **1200** can be implemented partly in a base station and partly in a mobile unit that communicates with the base station and provides a user interface.

Storage device **1212** can be implemented, e.g., using disk, flash memory, or any other non-transitory storage medium, or a combination of media, and can include volatile and/or non-volatile media. In some embodiments, storage device **1212** can store one or more application and/or operating system programs to be executed by processing subsystem **1210**, including programs to implement various operations described above as being performed by a controller. For example, storage device **1012** can store a uniform controller application that can read an accessory description record and generate a graphical user interface for controlling the accessory based on information therein (e.g., as described in above-referenced U.S. application Ser. No. 14/614,114). Storage device **1212** can also store program code executable to communicate with a relay service **220**, as shown in FIG. **2**, e.g., as described above. In some embodiments, portions (or all) of the controller functionality described herein can be implemented in operating system programs rather than applications. In some embodiments, storage device **1212** can also store apps designed for specific accessories or specific

categories of accessories (e.g., an IP camera app to manage an IP camera accessory or a security app to interact with door lock accessories).

User interface **1214** can include input devices such as a touch pad, touch screen, scroll wheel, click wheel, dial, button, switch, keypad, microphone **1216**, or the like, as well as output devices such as a video screen, indicator lights, speakers, headphone jacks, or the like, together with supporting electronics (e.g., digital-to-analog or analog-to-digital converters, signal processors, or the like). A user can operate input devices of user interface **1214** to invoke the functionality of controller **1200** and can view and/or hear output from controller **1200** via output devices of user interface **1214**.

Processing subsystem **1210** can be implemented as one or more integrated circuits, e.g., one or more single-core or multi-core microprocessors or microcontrollers, examples of which are known in the art. In operation, processing system **1210** can control the operation of controller **1200**. In various embodiments, processing subsystem **1210** can execute a variety of programs in response to program code and can maintain multiple concurrently executing programs or processes. At any given time, some or all of the program code to be executed can be resident in processing subsystem **1210** and/or in storage media such as storage device **1212**.

Through suitable programming, processing subsystem **1210** can provide various functionality for controller **1200**. For example, in some embodiments, processing subsystem **1210** can implement various processes (or portions thereof) described above as being implemented by a controller. Processing subsystem **1210** can also execute other programs to control other functions of controller **1200**, including application programs that may be stored in storage device **1212**. In some embodiments, these application programs may interact with an accessory, e.g., by generating messages to be sent to the accessory and/or receiving responses from the accessory. Such interactions can be facilitated by an accessory management daemon and/or other operating system processes, e.g., as described above, and can include communicating with the accessory via a relay service **220**, as shown in FIG. **2**, as described above.

Communication interface **1216** can provide voice and/or data communication capability for controller **1200**. In some embodiments communication interface **1216** can include radio frequency (RF) transceiver components for accessing wireless voice and/or data networks (e.g., using cellular telephone technology, data network technology such as 3G, 4G/LTE, Wi-Fi, other IEEE 802.11 family standards, or other mobile communication technologies, or any combination thereof), components for short-range wireless communication (e.g., using Bluetooth and/or Bluetooth LE standards, NFC, etc.), and/or other components. In some embodiments communication interface **1216** can provide wired network connectivity (e.g., Ethernet) in addition to or instead of a wireless interface. Communication interface **1216** can be implemented using a combination of hardware (e.g., driver circuits, antennas, modulators/demodulators, encoders/decoders, and other analog and/or digital signal processing circuits) and software components. In some embodiments, communication interface **1216** can support multiple communication channels concurrently or at different times, using the same transport or different transports. Thus, for example, controller **1200** can communicate with accessories via a local channel at some times and via a relay service **220**, as shown in FIG. **2**, at other times.

Secure storage module **1218** can be an integrated circuit or the like that can securely store cryptographic information for controller **1200**. Examples of information that can be stored within secure storage module **1218** include the controller's long-term public and secret keys **1222** (LTPKC, LTSKC), a list of local pairings **1224** (e.g., a lookup table that maps a local accessory identifier to an accessory long-term public key (LTPKA) for accessories that have completed a local pair setup or pair add process, e.g., as described above, with controller **1200**), and a list of relay pairings **1226** (e.g., accessory RAs and associated access tokens for accessories that have established a relay pairing, e.g., as described above, with controller **1200**). In some embodiments, pairing information can be stored such that a local pairing **1224** is mapped to the corresponding relay pairing **1226** in instances where both a local pairing and a relay pairing with the accessory have been established.

In some embodiments, cryptographic operations can be implemented in a cryptographic logic module **1220** that communicates with secure storage module **1218**. Physically, cryptographic logic module **1220** can be implemented in the same integrated circuit with secure storage module **1218** or a different integrated circuit (e.g., a processor in processing subsystem **1210**) as desired. Cryptographic logic module **1220** can include various logic circuits (fixed or programmable as desired) that implement or support cryptographic operations of controller **1200**, including any or all cryptographic operations described above. Secure storage module **1218** and/or cryptographic logic module **1220** can appear as a "black box" to the rest of controller **1200**. Thus, for instance, communication interface **1216** can receive a message in encrypted form that it cannot decrypt and can simply deliver the message to processing subsystem **1210**. Processing subsystem **1210** may also be unable to decrypt the message, but it can recognize the message as encrypted and deliver it to cryptographic logic module **1220**. Cryptographic logic module **1220** can decrypt the message (e.g., using information extracted from secure storage module **1218**) and determine what information to return to processing subsystem **1210**. As a result, certain information can be available only within secure storage module **1218** and cryptographic logic module **1220**. If secure storage module **1218** and cryptographic logic module **1220** are implemented on a single integrated circuit that executes code only from an internal secure repository, this can make extraction of the information extremely difficult, which can provide a high degree of security. Other implementations are also possible.

Further, while a controller is described herein with reference to particular blocks, it is to be understood that these blocks are defined for convenience of description and are not intended to imply a particular physical arrangement of component parts. Further, the blocks need not correspond to physically distinct components. Blocks can be configured to perform various operations, e.g., by programming a processor or providing appropriate control circuitry, and various blocks might or might not be reconfigurable depending on how the initial configuration is obtained. Embodiments of the present disclosure can be realized in a variety of apparatus including electronic devices implemented using any combination of circuitry and software.

Controllers and accessories described herein can be implemented in electronic devices that can be of generally conventional design. Such devices can be adapted to communicate using a uniform accessory protocol that supports command-and-control operations by which a controller (a first electronic device) can control operation of an accessory (a second electronic device). In some instances, a device can combine features or aspects of a controller and an accessory, e.g., in the case of a proxy as described above.

It will be appreciated that the system configurations and components described herein are illustrative and that variations and modifications are possible. It is to be understood that an implementation of controller **1200** can perform all operations described above as being performed by a media access device and that an implementation of accessory **1100** can perform any or all operations described above as being performed by an accessory. A proxy, bridge, tunnel, or coordinator can combine components of controller **1200** and accessory **1100**, using the same hardware or different hardware as desired. The media access device and/or accessory may have other capabilities not specifically described herein (e.g., mobile phone, global positioning system (GPS), broadband data communication, Internet connectivity, etc.). Depending on implementation, the devices can interoperate to provide any functionality supported by either (or both) devices or to provide functionality that is partly implemented in each device. In some embodiments, a particular accessory can have some functionality that is not accessible or invocable via a particular media access device but is accessible via another controller or by interacting directly with the accessory.

Further, while the media access device and accessory are described herein with reference to particular blocks, it is to be understood that these blocks are defined for convenience of description and are not intended to imply a particular physical arrangement of component parts. Further, the blocks need not correspond to physically distinct components. Blocks can be configured to perform various operations, e.g., by programming a processor or providing appropriate control circuitry, and various blocks might or might not be reconfigurable depending on how the initial configuration is obtained. Embodiments of the present disclosure can be realized in a variety of apparatus including electronic devices implemented using any combination of circuitry and software.

Disclosure

Various features described herein, e.g., methods, apparatus, computer-readable media and the like, can be realized using any combination of dedicated components and/or programmable processors and/or other programmable devices. The various processes described herein can be implemented on the same processor or different processors in any combination. Where components are described as being configured to perform certain operations, such configuration can be accomplished, e.g., by designing electronic circuits to perform the operation, by programming programmable electronic circuits (such as microprocessors) to perform the operation, or any combination thereof. Further, while the embodiments described above may make reference to specific hardware and software components, those skilled in the art will appreciate that different combinations of hardware and/or software components may also be used and that particular operations described as being implemented in hardware might also be implemented in software or vice versa.

Computer programs incorporating various features described herein may be encoded and stored on various computer readable storage media; suitable media include magnetic disk or tape, optical storage media such as compact disk (CD) or DVD (digital versatile disk), flash memory, and other non-transitory media. Computer readable media encoded with the program code may be packaged with a compatible electronic device, or the program code may be provided separately from electronic devices (e.g., via Internet download or as a separately packaged computer-readable storage medium).

As described above, one aspect of the present technology is the gathering and use of data available from various sources for use in a home networking environment. The present disclosure contemplates that in some instances, this gathered data may include personal information data that uniquely identifies or can be used to contact or locate a specific person. Such personal information data can include demographic data, location-based data, telephone numbers, email addresses, twitter ID's, home addresses, data or records relating to a user's health or level of fitness (e.g., vital signs measurements, medication information, exercise information), date of birth, or any other identifying or personal information.

The present disclosure recognizes that the use of such personal information data, in the present technology, can be used to the benefit of users. For example, the personal information data can be used to control home network devices. Further, other uses for personal information data that benefit the user are also contemplated by the present disclosure. For instance, health and fitness data may be used to provide insights into a user's general wellness, or may be used as positive feedback to individuals using technology to pursue wellness goals.

The present disclosure contemplates that the entities responsible for the collection, analysis, disclosure, transfer, storage, or other use of such personal information data will comply with well-established privacy policies and/or privacy practices. In particular, such entities should implement and consistently use privacy policies and practices that are generally recognized as meeting or exceeding industry or governmental requirements for maintaining personal information data private and secure. Such policies should be easily accessible by users, and should be updated as the collection and/or use of data changes. Personal information from users should be collected for legitimate and reasonable uses of the entity and not shared or sold outside of those legitimate uses. Further, such collection/sharing should occur after receiving the informed consent of the users. Additionally, such entities should consider taking any needed steps for safeguarding and securing access to such personal information data and ensuring that others with access to the personal information data adhere to their privacy policies and procedures. Further, such entities can subject themselves to evaluation by third parties to certify their adherence to widely accepted privacy policies and practices. In addition, policies and practices should be adapted for the particular types of personal information data being collected and/or accessed and adapted to applicable laws and standards, including jurisdiction-specific considerations. For instance, in the US, collection of or access to certain health data may be governed by federal and/or state laws, such as the Health Insurance Portability and Accountability Act (HIPAA); whereas health data in other countries may be subject to other regulations and policies and should be handled accordingly. Hence different privacy practices should be maintained for different personal data types in each country.

Despite the foregoing, the present disclosure also contemplates embodiments in which users selectively block the use of, or access to, personal information data. That is, the present disclosure contemplates that hardware and/or software elements can be provided to prevent or block access to such personal information data. For example, in the case of home network control, the present technology can be configured to allow users to select to "opt in" or "opt out" of participation in the collection of personal information data during registration for services or anytime thereafter. In

another example, users can select not to provide person information for home network setup. mood-associated data for targeted content delivery services. In yet another example, users can select to limit the amount of personal data is maintained by the home network. In addition to providing "opt in" and "opt out" options, the present disclosure contemplates providing notifications relating to the access or use of personal information. For instance, a user may be notified upon downloading an app that their personal information data will be accessed and then reminded again just before personal information data is accessed by the app.

Moreover, it is the intent of the present disclosure that personal information data should be managed and handled in a way to minimize risks of unintentional or unauthorized access or use. Risk can be minimized by limiting the collection of data and deleting data once it is no longer needed. In addition, and when applicable, including in certain health related applications, data de-identification can be used to protect a user's privacy. De-identification may be facilitated, when appropriate, by removing specific identifiers (e.g., date of birth, etc.), controlling the amount or specificity of data stored (e.g., collecting location data a city level rather than at an address level), controlling how data is stored (e.g., aggregating data across users), and/or other methods.

Therefore, although the present disclosure broadly covers use of personal information data to implement one or more various disclosed embodiments, the present disclosure also contemplates that the various embodiments can also be implemented without the need for accessing such personal information data. That is, the various embodiments of the present technology are not rendered inoperable due to the lack of all or a portion of such personal information data. For example, content can be selected and delivered to users by inferring preferences based on non-personal information data or a bare minimum amount of personal information, such as the content being requested by the device associated with a user, other non-personal information available to the home network, or publicly available information.

Thus, although the disclosure has been described with respect to specific embodiments, it will be appreciated that the disclosure is intended to cover all modifications and equivalents within the scope of the following claims.

The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense. It will, however, be evident that various modifications and changes may be made thereunto without departing from the broader spirit and scope of the disclosure as set forth in the claims.

Other variations are within the spirit of the present disclosure. Thus, while the disclosed techniques are susceptible to various modifications and alternative constructions, certain illustrated embodiments thereof are shown in the drawings and have been described above in detail. It should be understood, however, that there is no intention to limit the disclosure to the specific form or forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions and equivalents falling within the spirit and scope of the disclosure, as defined in the appended claims.

The use of the terms "a," "an," and "the," and similar referents in the context of describing the disclosed embodiments (especially in the context of the following claims), are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. The term "connected" is to be construed as partly or wholly contained within, attached to, or joined together, even if there is something intervening. The phrase "based on" should be understood to be open-ended, and not limiting in any way, and is intended to be interpreted or otherwise be read as "based at least in part on," where appropriate. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate embodiments of the disclosure and does not pose a limitation on the scope of the disclosure unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the disclosure.

Disjunctive language such as the phrase "at least one of X, Y, or Z," unless specifically stated otherwise, is otherwise understood within the context as used in general to present that an item, term, etc., may be either X, Y, or Z, or any combination thereof (e.g., X, Y, and/or Z). Thus, such disjunctive language is not generally intended to, and should not, imply that certain embodiments require at least one of X, at least one of Y, or at least one of Z to each be present. Additionally, conjunctive language such as the phrase "at least one of X, Y, and Z," unless specifically stated otherwise, should also be understood to mean X, Y, Z, or any combination thereof, including "X, Y, and/or Z."

Preferred embodiments of this disclosure are described herein, including the best mode known to the inventors for carrying out the disclosure. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the disclosure to be practiced otherwise than as specifically described herein. Accordingly, this disclosure includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the disclosure unless otherwise indicated herein or otherwise clearly contradicted by context.

All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

What is claimed is:

1. A method, comprising:

receiving, by a first computing device connected to a network, a network code for adding a second computing device configured to control one or more accessories connected with the first computing device;

transmitting, by the first computing device, a first signal to the second computing device, the first signal configured to register the second computing device to receive configuration information from the first computing device;

transmitting, by the first computing device, a second signal to the second computing device, the second

signal comprising the configuration information for the second computing device, the configuration information associating a function of the first computing device with a user interface element value for the second computing device;

receiving, by the first computing device, a third signal from the second computing device, the third signal comprising audio information captured by the second computing device; and

causing, by the first computing device, execution of one or more operations based at least in part on the audio information captured by the second computing device, wherein the causing comprises transmitting an instruction to the one or more accessories for execution by the one or more accessories.

2. The method of claim **1**, further comprising transcribing, by the first computing device, the audio information into a partial transcript of text, wherein the partial transcript of text comprises one or more characters of text.

3. The method of claim **2**, further comprising:

preparing for output, by the first computing device, the partial transcript of text, wherein the output comprises at least one of displaying the partial transcript of text on a display and announcing the partial transcript of text via a speaker.

4. The method of claim **1**, further comprising:

identifying, by the first computing device, a change in the configuration information for the first computing device; and

transmitting, by the first computing device, a fourth signal that includes revised configuration information for associating functions of the first computing device with the user interface element value for the second computing device.

5. The method of claim **1**, further comprising:

synchronizing the control of the one or more accessories such that a command from the second computing device will perform a related function for each of a same type of accessory.

6. The method of claim **1**, further comprising causing an interface of the second computing device to display representations of one or more accessories on a display of the second computing device.

7. The method of claim **1**, further comprising:

receiving, from the second computing device, authorization for the first computing device to control one or more accessories of various types that are wirelessly connected to the second computing device;

synchronizing control of the one or more accessories such that a command from the first computing device will perform a related function for each of a same type of accessory; and

providing an interface for a user to select the one or more accessories on the first computing device.

8. The method of claim **1**, further comprising:

receiving, by the first computing device, a request from the second computing device to open a channel;

opening, by the first computing device, the channel for reception of the third signal containing data;

transmitting, by the first computing device, a fifth signal to the second computing device, the fifth signal comprising a transmit identifier, a status, an address, and a port identifier; and

receiving, by the first computing device, information via the third signal, the information including data from the second computing device.

9. The method of claim **1**, further comprising performing, by the first computing device, the one or more operations on the first computing device.

10. A non-transitory computer-readable medium storing a plurality of instructions that, when executed by one or more processors of a first computing device, cause the one or more processors of the first computing device to perform operations comprising:

receiving, by the first computing device for a network, a network code for adding a second computing device configured to control one or more accessories connected with the second computing device, the network code identified via a user interface of an application for the network;

transmitting, by the first computing device, a first signal to the second computing device, the first signal configured to register the second computing device to receive configuration information from the first computing device;

transmitting, by the first computing device, a second signal to the second computing device, the second signal comprising the configuration information for the second computing device, the configuration information associating a function for the first computing device with a user interface element value for the second computing device;

receiving, by the first computing device, a third signal from the second computing device, the third signal comprising audio information captured by the second computing device; and

causing, by the first computing device, execution of one or more operations based at least in part on the audio information captured by the second computing device, wherein the causing comprises transmitting an instruction to the one or more accessories for execution by the one or more accessories.

11. The non-transitory computer-readable medium of claim **10**, further comprising additional instructions comprising transcribing, by the first computing device, the audio information into a partial transcript of text, wherein the partial transcript of text comprises one or more characters of text.

12. The non-transitory computer-readable medium of claim **11**, further comprising additional instructions comprising preparing for output, by the first computing device, the partial transcript of text, wherein the output comprises at least one of displaying the partial transcript of text on a display and announcing the partial transcript of text via a speaker.

13. The non-transitory computer-readable medium of claim **10**, further comprising:

identifying, by the first computing device, a change in the configuration information for the first computing device; and

transmitting, by the first computing device, a fourth signal that includes revised configuration information for associating functions of the first computing device with the user interface element value for the second computing device.

14. The non-transitory computer-readable medium of claim **10**, further comprising:

receiving, from the second computing device, authorization for the second computing device to control one or more accessories of various types that are wirelessly connected to the second computing device;

synchronizing control of the one or more accessories such that a command from the second computing device will perform a related function for each of a same type of accessory; and

providing an interface for a user to select the one or more accessories on the second computing device.

15. The non-transitory computer-readable medium of claim **10**, further comprising receiving authorization information configured to authorize the first computing device to control one or more proprietary accessories of various types that are wirelessly connected to the second computing device.

16. The non-transitory computer-readable medium of claim **10**, further comprising:

receiving, by the first computing device, a request from the second computing device to open a channel;

opening, by the first computing device, the channel for reception of the third signal, wherein the third signal contains data;

transmitting, by the first computing device, a fifth signal to the second computing device, the fifth signal comprising a transmit identifier, a status, an address, and a port identifier; and

receiving, by the first computing device, an information via the third signal, the information including data from the second computing device.

17. A first computing device for a network, comprising:

one or more memories; and

one or more processors in communication with the one or more memories and configured to execute instructions stored in the one or more memories to:

receive a network code for adding a second computing device configured to control one or more accessories connected with the first computing device the network code identified via a user interface of an application for the network;

transmit a first signal to the second computing device, the first signal configured to register the second computing device to receive configuration information from the first computing device;

transmit a second signal to the second computing device, the second signal comprising the configuration information for the second computing device, the configuration information associating a function for the first computing device with a user interface element value for the second computing device;

receive, by the first computing device, a third signal from the second computing device, the third signal comprising audio information captured by the second computing device; and

cause, by the first computing device, execution of one or more operations based at least in part on the audio information captured by the second computing device, wherein the causing comprises transmitting an instruction to the one or more accessories for execution by the one or more accessories.

18. The first computing device of claim **17**, wherein the one or more processors are further configured to execute the instructions to:

transcribing, by the first computing device, the audio information into a partial transcript of text, wherein the partial transcript of text comprises one or more characters of text; and

preparing for output, by the first computing device, the partial transcript of text, wherein the output comprises at least one of displaying the partial transcript of text on a display and announcing the partial transcript of text via a speaker.

19. The first computing device of claim **17**, wherein the one or more processors are further configured to execute the instructions to:

identify a change in the configuration information for the first computing device; and

transmit a fourth signal that includes revised configuration information for associating functions of the first computing device with the user interface element value for the second computing device.

20. The first computing device of claim **17**, wherein the one or more processors are further configured to execute the instructions to:

receive, from the second computing device, authorization for the second computing device to control one or more accessories of various types that are wirelessly connected to the second computing device;

synchronize control of the one or more accessories such that a command from the first computing device will perform a related function for each of a same type of accessory; and

provide an interface for a user to select the one or more accessories on the first computing device.

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